THE

PROCEEDINGS

OF THE

Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

Volume XXIII - Parts 1-2-3-4

Sessions 1950-1954

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Editor: H. Ritchie Chipman
Editorial Board: H. L. Bronson, Dixie Pelluet and J. A. McCarter
Printed for the Institute by the Imperial Press Limited
Date of Publication: March 1953

PROCEEDINGS

OF THE

Nova Scotian Institute of Science

SESSION OF 1950-51
Vol. XXIII, Part 1

THE FRESH WATER FISHES OF NOVA SCOTIA

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(Received for Publication 22nd Nov. 1951)

ABSTRACT

Keys are given for the identification of forty-four species of freshwater fishes, only thirty-three of which are definitely known to occur in Nova Scotia. Of these thirty-three, four have been introduced, seventeen are believed to have entered through the sea, and twelve are more or less strictly freshwater forms. Detailed information on occurence within the Province, a synoptic account of total range and a short descriptive account are given for each Nova Scotia species.

The distribution pattern indicates that the twelve strictly freshwater species have entered Nova Scotia by way of the Isthmus of Chignecto since the recession of the last ice sheet. There is some evidence that the nature of the local rock formation influences the distribution of several species.

SOURCES OF INFORMATION

The information concerning occurrence and distribution of fresh-water fishes in Nova Scotia was obtained mainly from seventy-three collections made by the author during the years 1947-50 inclusive. The collection localities are scattered throughout the province, but the Cumberland-Colchester-Pictou area has been covered less thoroughly than the rest of Nova Scotia. Also used were some fishes collected during 1946 by the Nova Scotia Inland Fisheries Survey and the

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previous collections of the Nova Scotia Museum of Science, a rather poorly assorted lot of miscellaneous fishes, in most cases consisting of only a few specimens of one or two species from each locality and in many cases without even minimum information concerning collector, date, and locality of collection. Further data concerning the distribution of *Cyprinidae* in the province were obtained from the files of the Royal Ontario Museum of Zoology.

The collections of the present author and the 1946 collections of the Nova Scotia Inland Fisheries Survey will be added to those of the Museum of Science. The 1949 and 1950 collections, 48 in all, are accompanied in most cases by full information concerning date, place, and methods of capture, water and air temperature, water colour and pH, vegetation and nature of bottom. The earlier collections are accompanied by scantier field notes.

The combined collection will provide a nucleus for the detailed study of many aspects of fish biology, such as breeding times, growth, diet, habitat preference and ecological interrelation.

The information on ranges was taken from Hubbs and Lagler's "Fishes of the Great Lakes Region," J. R. Dymond's "A List of the Freshwater Fishes of Canada" and Jordon and Evermann's "Fishes of North and Middle America", in that order. Most of the keys are modified from the same sources.

METHODS

Although poison, lime bomb, D. C. electric shocker, trawl, rod with fly, spinner or bait, dip net, minnow trap, four-angled lift net, hoop lift net, gill net, triple-fyke net with leaders, and four-foot seines in lengths from 6 to 150 feet were all used in the field work, the great bulk of the specimens were taken with 4 x 25 foot seine without brails, operated by two men, at least one of whom wore a swimming suit and sneakers. Almost all the seining was done during the day.

The fish were fixed in 4% formaldehyde solution, and preserved in either 4% formaldehyde or 70% alcohol.

MARINE FISHES

A number of sea fishes, such as the Saltwater Killifish; *Fundulus heteroclitus*; the Silverside, *Menidia notata*; and the Winter Flounder, *Pseudopleuronectes americanus*; are said to invade brackish water almost or quite to fresh water. Except for a single specimen of *Fundulus heteroclitus* they have not been found in fresh water, even in the tidal reaches of rivers, during this investigation. Persons collecting in such places, however, should bear them in mind.

GENERAL REMARKS

The most striking characteristic of the fresh-water fish fauna of Nova Scotia is the small number of species and the variety of places where each species lives. Thus half a dozen seine hauls in a place such as the Huron River in Michigan will yield fifteen or more species of fish, but in no case has a day's careful seining on a lake or stream in Nova Scotia yielded more than seven or eight species. Most lakes and streams will provide only three or four. Agassiz once called New England a "zoological island." The description applies even more closely to Nova Scotia.

In the more isolated regions of the province this is particularly marked. Bluff Lake, a small pond in the granite area of the Halifax Peninsula, contains only Speckled Trout, *Fundulus diaphanus*, and probably Eels. The Bluff Lake *Fundulus* grow to a large size and these large individuals can be seen swimming amongst the rooted aquatic vegetation not only near shore, where they usually occur, but also out in deeper water, in regions held by large Golden Shiners and White and Yellow Perch in similar lakes with a richer fauna.

Even more striking examples of the sparse fish fauna are to be found on the plateau of northern Cape Breton Island. This plateau drops off to the sea very precipitously, the streams draining its lakes being cataracts along much of their courses. This appears to have effectively sealed off the plateau from most fish, and although Speckled Trout (possibly introduced) seem to occur in all the lakes large and cool enough to support them, there are no other fish which can be taken by seining in the lakes of the plateau. In the place of the Killifish, the various sticklebacks, the minnows and young suckers which populate the shallows of most Nova Scotian lakes, the lakes of the plateau support a very heavy population of the newt, *Triturus viridescens*, which occurs elsewhere in the Province, but nowhere in such numbers.

Although a total of forty-four species is treated in the present paper, the number is deceptively large. The following eleven are not definitely known to occur here, but are included partly because further collecting may disclose their presence and partly for the convenience of people in New Brunswick who may wish to use the keys:

	Page
1. Johnny Darter, *Boleosoma nigrum*	64
2. Eastern Sturgeon Sucker, *Catostomus catostomus*	33
3. Common Slimy Muddler, *Cottus cognathus*	67
4. Creek Chubsucker, *Erimyzon oblongus*	30
5. Brook Stickleback, *Eucalia inconstans*	71
6. Pumpkinseed, *Lepomis gibbosus.* (one record)	66
7. Fallfish, *Leucosomus corporalis*	37
8. Burbot, *Lota lota maculosa*	59
9. Finescale Dace, *Pfrille neogara*	43
10. Blueback, *Pomolobus aestivalis*	20
11. Alpine Trout, *Salvelinus alpinus*	26

In addition the following four are known to be introduced forms not native to the province.

	Page
1. Chain Pickerel, *Esox niger*	53
2. Small mouth Bass, *Micropterus d. dolomieu*	64
3. Rainbow Trout, *Salmo gairneri*	23
8. Brown Trout, *Salmo trutta*	24

Of the remaining twenty-nine, seventeen are species which either spend a large part of their lives in salt water or venture into it as a matter of course:

	Page
1. Sturgeon, *Acipenser oxyrynchus*	18
2. Shad, *alosa sapidissima*	20

3.	Eel, *Anguilla rostrata*, Le Sueur	55
4.	Four-spine Stickleback, *Apeltes quadracus*	68
5.	Common Whitefish, *Coregonus clupeaformis*	28
6.	Lake Trout, *Cristivomer namaycush.*,(?)	26
7.	Three-spine Stickleback, *Gasterosteus aculeatus*	69
8.	Tomcod, *Microgadus tomcod*	60
9.	White Perch, *Morone americana*	61
10.	Smelt, *Osmerus mordax*	29
11.	Lamprey, *Petromyzon marinus*	16
12.	Gaspereau, *Pomolobus pseudoharengus*	21
13.	Round Whitefish, *Prosopium cylindraceum*, (one record)	27
14.	Nine-spine Stickelback, *Pungitius pungitius*	70
15.	Striped bass, *Roccus saxatilis*	60
14.	Atlantic salmon, *Salmo salar*	23
17.	Brook trout. *Salvelinus fontinalis*	25

Lake Trout, *Cristivomer namaycush*, is included in this list with some hesitation. There is no positive evidence available that it does venture readily into salt water. It is a lake-spawning fish and is not so likely to migrate anywhere as most salmonids, but it seems quite probable that it is able to tolerate sea water. In any case its distribution in Nova Scotia is not well known enough at present to add anything to our understanding of the factors which control fresh-water fish distribution. For these reasons it is included tentatively among the fishes which are to be found in every place that they can live which is accessible from the sea.

There remain, then, only the following twelve purely fresh-water species which are native to this province.

		Page
1.	Catfish, *Ameiurus n. nebulosus*	50
2.	Sucker, *Catostomus c. commersonni*	30
3.	Northern Redbelly Dace, *Chrosomus eos*	41
4.	Northern Lake Chub, *Couesius p. plumbeus*	35
5.	Fundulus, Killifish, *Fundulus d. diaphanus*	56
6.	Northern Pearl Dace, *Margariscus margarita nachtriebi*	40
7.	Eastern Golden Shiner, *Notemigonus c. crysoleucas*	43
8.	Common Shiner, *Notropis cornutus*	47
9.	Northern Blacknose Shiner, *Notropis h. heterolepis*	46
10.	Yellow Perch, *Perca flavescens*	62

11. Eastern Blacknose Dace, *Rhinicthys a. atratulus* 35
12. Northern Creek Chub, *Semotilus a. atromaculatus* 37

These twelve species are the fishes which must be dealt with most closely in any consideration of the mechanisms of fresh-water fish dispersal. Their present distribution, in so far as it is known, is plotted in Figure 1.

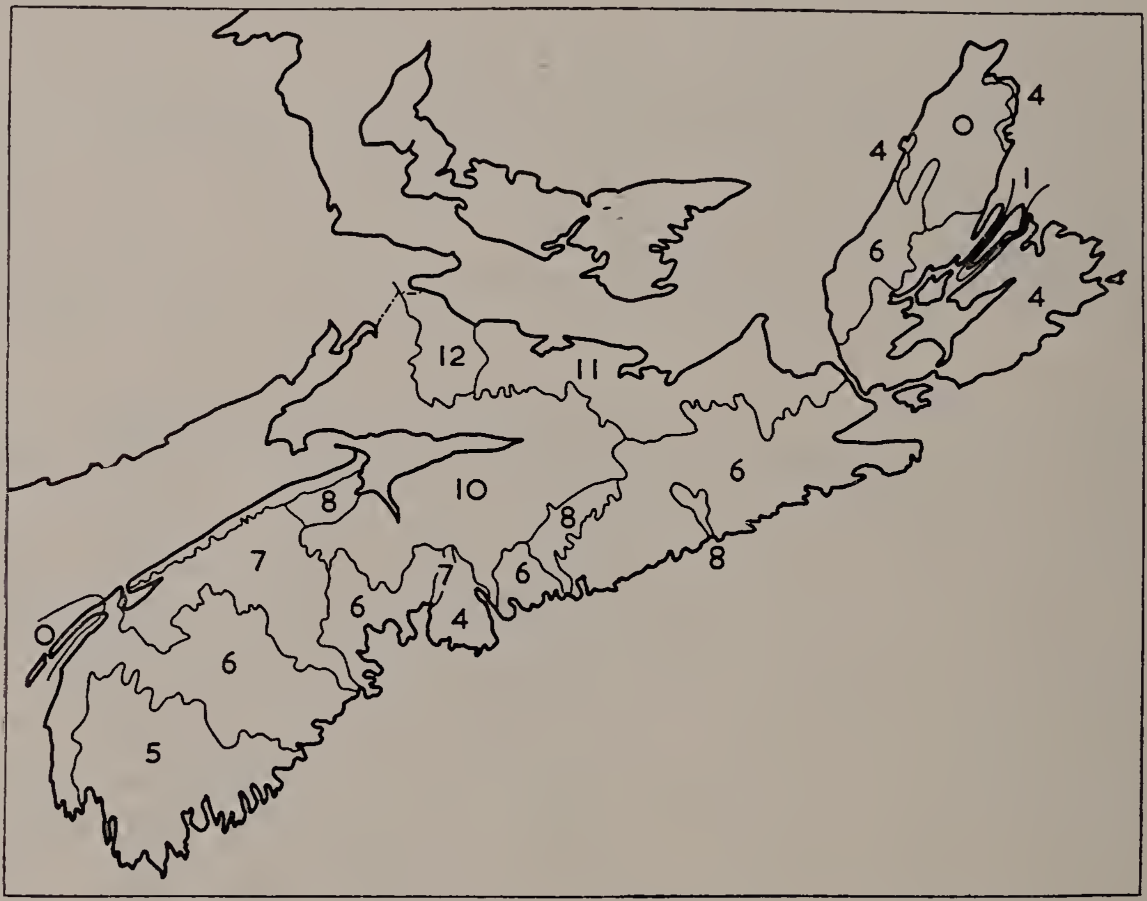


Figure 1: Distribution of fresh water fishes in Nova Scotia. The numbers denote the number of species in each area which do not venture freely into the sea.

This map admittedly rests on a comparatively small number of collections, and further work is bound to bring its inaccuracies to light. The general picture, however, is one of a series of rings centred upon the Isthmus of Chignecto, each ring representing the range limit of one or more species, so that all twelve are found in northern Cumberland County, and fewer and fewer towards the extremities of the Province. By the time Digby Neck and the plateau of northern Cape Breton Island are reached, we no longer find a single one of the fishes under consideration.

These rings are not, of course, perfect circles, because they follow the divides of the watersheds. In a general way, there is a rich fish fauna in the northern half of the province, a poor one in the southern half, depending on the presence or absence of the following minnows:

Northern Redbelly Dace, *Chrosomus eos.*
Northern Lake Chub, *Couesius p. plumbeus.*
Northern Pearl Dace, *Margariscus margarita nachtriebi.*
Common Shiner, *Notropis cornutus.*
Northern Blacknose Shiner, *Notropis h. heterolepis.*

In only a few places have any of these minnows broken through the backbone of the province to reach the Atlantic drainages. Examples are *Couesius plumbeus* in the La Have River, Lunenburg County, *Notropis cornutus* in Pockwock Lake, Halifax County, *Notropis cornutus* and *Couesius plumbeus* in the Musquodoboit and Moser Rivers, Halifax County. The occurrence of several minnows in the Dartmouth Lakes chain is to be regarded as a special case, since these lakes are properly part of the Shubenacadie River system, their connection to Halifax Harbour being an artificial one.

The only discontinuity of range is provided by the Moser River system which in the light of present knowledge seems to support a population of *Couesius plumbeus* and *Notropis cornutus* separated from the main range of these species. The Moser River records, however, are from the files of the Royal Ontario Museum of Zoology, and are a reflection of the fact that this stream was intensively investigated for two years by the Fisheries Research Board of Canada. Thorough collection might well reveal the presence of these two minnows in the adjacent river systems. It is indeed to be expected that several additional species could be found in many of the river systems, but at any given level of collecting intensity the relative richness of the fish populations in the various drainages should be approximately the same, although the absolute numbers might change.

This lack of range discontinuities indicates that complete destruction of the pre-Pleistocene fish fauna occurred during the glaciation of Nova Scotia, and that the species now here have repopulated the province since the recession of the ice sheet. The species abundance in the various regions indicates that they entered Nova Scotia by way of the present Isthmus of Chignecto, not by some land bridge no longer existing.

A portion of the Nova Scotia vascular flora consists of plants commonly found much farther south. This has led botanists to suggest that these plants entered over the exposed coastal plain at a time when the relative sea level was much lower (Fernald 1918, 1921, 1924). Although this suggestion may be challenged on other grounds, such as the lack of physiographic evidence of extensive recent subsidence (Goldthwait 1924), the distribution of fishes does not necessarily refute it. If the contour of the sea bottom between Nova Scotia and New England were the same as it is today, and the relative sea level were fifty fathoms lower, George's Bank would form part of a broad peninsula joined to Cape Cod and Long Island, the Nova Scotia coastline would extend much farther southwest, and Brown Bank would form an island in between them (U.S. Coast and Geodetic Survey Chart *Cape Sable to Cape Hatteras* scale 1/1200,000, issued Feb. 1881). Under these circumstances it would be quite possible for vascular plants to invade Nova Scotia over the coastal plain from the south, but the remaining salt water gaps of twenty-eight and nineteen miles would present a formidable barrier to fresh-water fishes moving up the coastal plain towards Nova Scotia. A fall of at least one hundred and fifty fathoms in relative sea level would be required for fresh-water fishes to enter Nova Scotia over George's and Brown Banks.

Though the fish fauna of Nova Scotia is poor in number of species and each species lives in a great variety of places, the number of species is increasing by natural diffusion and much more rapidly by artificial stocking. It is interesting to consider what changes are likely to occur as this process goes on.

As the variety of species becomes greater the territory occupied by each species will decrease. For example, *Fundulus* *diaphanus* now lives, among other places, in swift-flowing streams. It will probably be displaced from the swift streams by *Cottus cognathus* when it reaches here, for in the parts of North America where the two co-exist it is *Cottus* which occupies the riffles while *Fundulus* is restricted to the lakes and slow streams.

Similarly the salmonids will probably disappear from many of the marginal waters in which they now occur when faced by the competition of pikes and centrarchids. An example has already been given by *Esox niger* in Digby County. This pickerel was introduced in a small lake with no outlet near Comeauville about a generation ago. It has since spread to the nearby Spectacle Brook drainage where it is now very common and where the trout population has declined to almost nothing.

The present fish fauna of Nova Scotia is characterised by large numbers of salmonids which are highly regarded as game fishes, and the introduction of new species is very likely to decrease the population of these salmonids. It is advisable, therefore, for those concerned with fisheries management to consider all the foreseeable consequences before artificially introducing new species of fish.

If the twelve fresh-water species arrived at the Isthmus of Chignecto at the same time, the range differences they present today must be indicative of either differences in habitat preference or differences in dispersal rate. If they did not arrive at the isthmus simultaneously, then the order in which they did arrive should bear some relation to their rates of dispersal, so it may be interesting to search for a correlation between existing ranges and factors which might affect speed of dispersal. The approximate descending order of range extent is as follows:

	Page
Killifish *Fundulus d. diaphanus*. Figure 25	56
Common Sucker, *Catostomus c. commersonni*. Figure 5	30
Eastern Golden Shiner, *Notemigonus c. crysoleucas*, Figure 16	43
Northern Creek Chub, *Semotilis a. atromaculatus*. Figure 10	37

Yellow Perch, *Perca flavescens.* Figure 29	62
Catfish, *Ameiurus n. nebulosus.* Figure 22	50
Northern Lake Chub, *Couesius p. plumbeus.* Figure 8	35
Common Shiner, *Notropis cornutus.* Figure 20	47
Northern Redbelly Dace, *Chrosomus eos.* Figure 14	41
Northern Pearl Dace, *Margariscus margarita nachtribei.* Figure 12	40
Northern Blacknose Shiner, *Notropis h. heterolepis.* Figure 18	46
Eastern Blacknose Dace *Rhinichthys a. atratulus.* Figure 7	35

An obvious method of fish dispersal which might be species-selective is migration around from stream to stream by the sea. It should be interesting therefore to consider the salinity tolerance of these fishes, especially the first six which are of almost universal distribution throughout the province. The first, *Fundulus diaphanus*, belongs to a family which is characteristic of salt and brackish water. It would not be surprising to find that *F. diaphanus* was capable of enduring moderate salinities, or even full sea water, for a short time. *Catostomus commersonni* thrives in the Quill Lakes, Saskatchewan, which have a salinity about half that of sea-water, while *Perca flavescens* and "catfish" (possibly *Ameiurus*) have been reared successfully in the similar water of Devil's Lake, North Dakota (Huntsman, 1922). It is commonly believed by ichthyologists (Hubbs, Carl L., personal communication) that *Notemigonus crysoleucas* is able to migrate from stream to stream through the sea. To sum up, then, it is rather to be expected that five of the six most widely distributed species are capable of at least a limited amount of dispersal by sea. Admittedly the evidence is not completely convincing. Two of the alleged salt-tolerating species, *Amieurus nebulosus* and *Perca flavescens*, do not seem to have bridged the Strait of Canso, and both *Margariscus margarita* and *Chrosomus eos* have done so, although neither of them is believed to tolerate sea water. It seems that the fishes of wide dispersal in Nova Scotia are those which have some salinity tolerance, but experimental data on the salinity tolerance of the species in question would be welcome.

Presence or absence of a fish species from a given body of water depends not only upon the ability of the species to reach the water, but also upon its ability to survive there. A factor which seems to limit the fish fauna of Nova Scotia lakes and streams is the rock formation in which they are situated. Unfortunately the field work of this study was mostly conducted in regions where it was not possible to separate clearly the effects of dispersal and of rock formation. It was, however, noticed that in rich farming country, i.e. regions of slate, sandstone or limestone, the number of species was larger than in the barren areas of granite, quartzite and diorite. For a few species the evidence is rather clear-cut:

Apeltes quadracus has never been found in fresh water in granite areas, although, being freely tolerant of sea water (in fact some believe it to be intolerant of fresh water) it is very widely distributed in Nova Scotia. Although it is never wise to be dogmatic about the absence of a fish from any given region, it seems unlikely that further collecting will disclose the presence of *Apeltes quadracus* in the granite areas. The Halifax Peninsula has been very thoroughly collected, for it is convenient to the city of Halifax and contains the seven experimental lakes used by Hayes and co-workers in their limnological studies. It is composed almost entirely of granite except for a small patch of Lower Carboniferous soft rocks near Seabright on the St. Margaret's Bay shore. *Apeltes quadracus* has been found in Brine Lake in this soft-rock region, but nowhere else on the Peninsula. It appears that *Apeltes quadracus* cannot tolerate the low salt content of the very soft waters flowing over granite areas.

Morone americana and *Ameirus nebulosus* are two other fishes of very wide range which have not been found in granite areas and it appears likely that they do not thrive under the conditions prevailing in such areas. The minnows *Notropis heterolepis*, *Margariscus margarita* and *Chrosomus eos* have not been found in granite regions, perhaps because these species, which have a rather narrow distribution, have not yet reached the hard-rock areas.

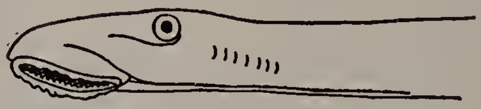
To sum up, the distribution of fresh-water fish species in Nova Scotia indicates very strongly that the post-glacial recolonization of the Province is still going on. The small number of species in parts of the Province may be due in part to the unsuitability of hard-rock areas for some fishes. The present small number of species is increasing gradually by migration, over the Isthmus of Chignecto and more quickly by artificial stocking. As new fishes enter, the present ones will be driven from marginal waters and restricted to those waters where they thrive better then the newcomers.

KEY TO THE FAMILIES OF FRESH WATER FISHES

1. Body nake-shaped —see 2

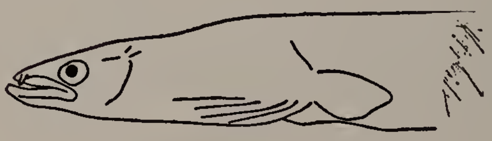
Body fish-shaped—see 3

2. Sucker-like mouth without jaws, gill slits 7—the lamprey family, *Petro myzonidae.* Page 16

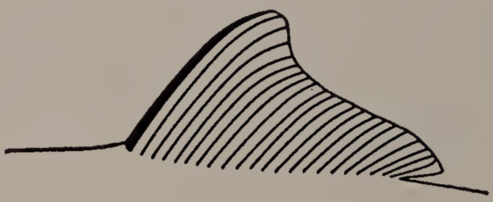


Mouth with jaws, gill slits 1—the eel family,

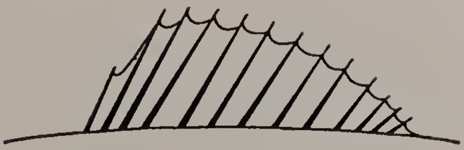
Anguillidae. Page 55.



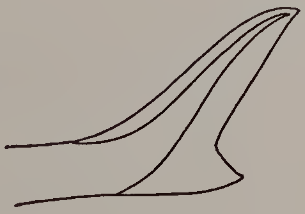
3. Fins with one spine or none—see 4.



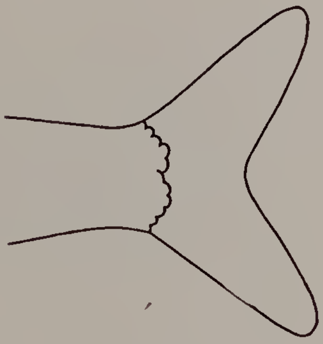
Fins with more than one spine—see 14



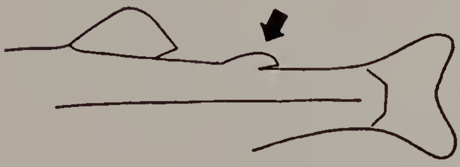
4. Tail heterocercal—the sturgeon family, *Acipenseridae*. Page 18.



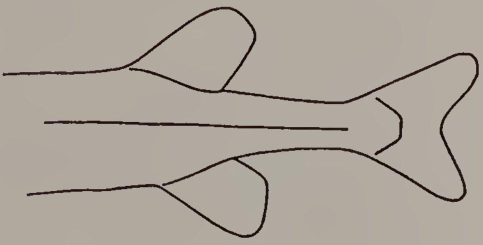
Tail homocercal—see 5



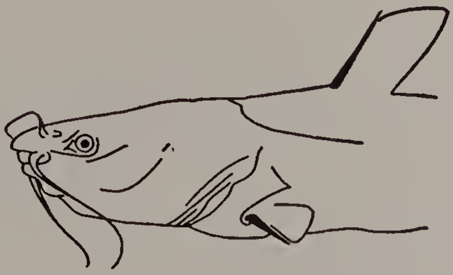
5. Adipose fin present—see 6



Adipose fin absent—see 9



6. Barbels about mouth, body scaleless—the North American catfish family, *Ameiuridae*. Page 50.

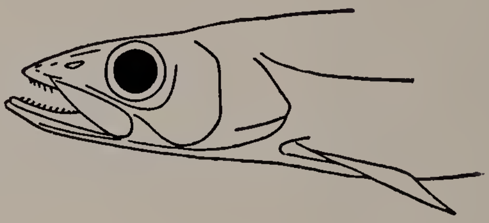


No barbels, body-scales —see 7

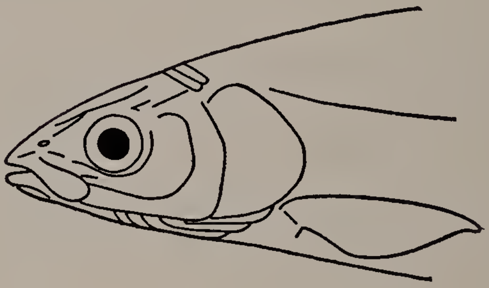
7. Scales in lateral line usually more than 100—the salmon family. *Salmonidae* Page 22

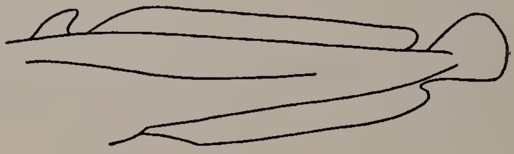
Scales in lateral line fewer than 100—see 8

8. Teeth strong—the smelt family, *Osmeridae*. Page 29

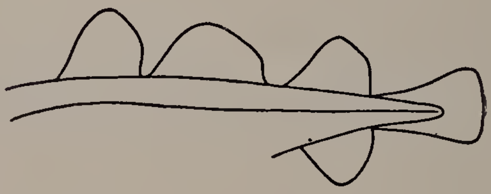


Teeth weak or absent—the whitefish family—*Coregonidae*. Page 26

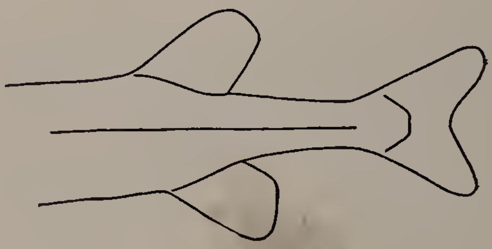




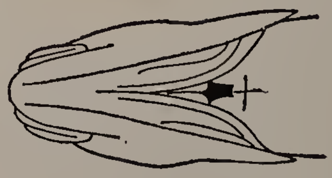
9. 2 or 3 dorsal fins—the cod family, *Gadidae*. Page 59



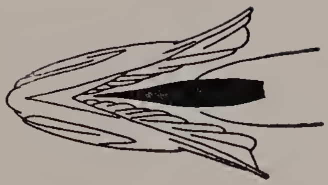
1 dorsal fin—see 10



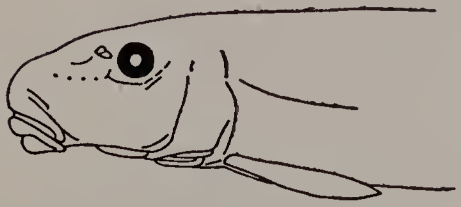
10. Gill membranes joined to isthmus—see 11.



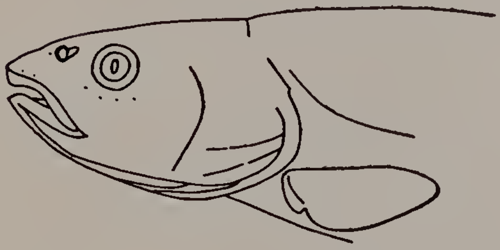
Gill membrane free from isthmus—see 12



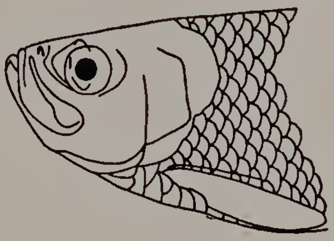
11. Mouth ventral, with thick lips—the sucker family, *Catostomidae.* Page 30



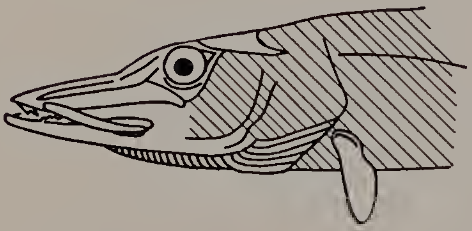
Mouth terminal—the minnow family, *Cyprinidae.* Page 33



12. Head naked—the herring family, *Clupeidae.* Page 19.



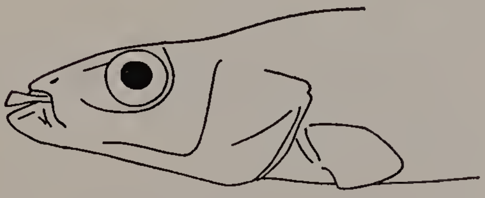
Head scaled—see 13.



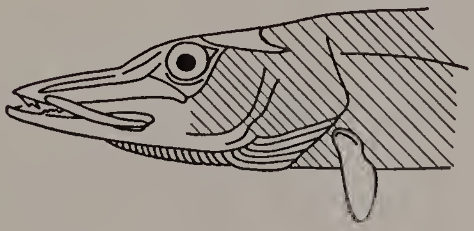
13. Body scaled—see 14.

Body scaleless—the sculpin family, *Cottidae.* Page 67.

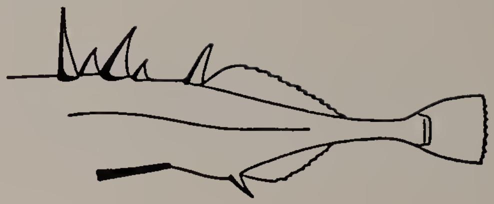
14. Upper jaw protractile—the killifish family, *Cyprinodontidae.* Page 56



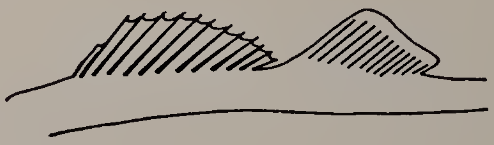
Upper jaw not protractile—the pike family, *Esocidae.* Page 53.



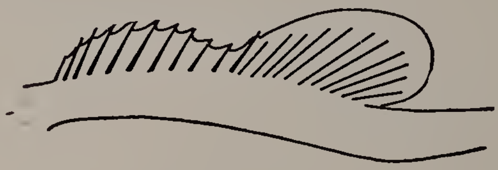
15. Dorsal spines isolated—the stickleback family, *Gasterosteidae.* Page 67.



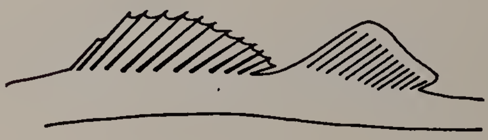
Dorsal spines connected by membrane—see 15.



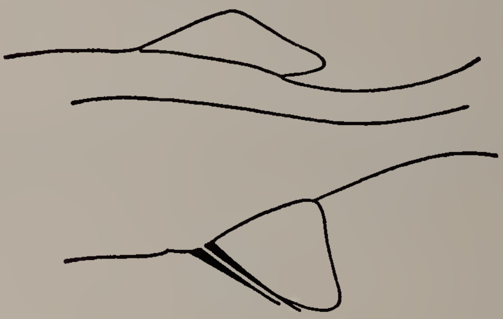
16. Dorsal fin single—the sunfish family, *Centrarchidae.* Page 64.



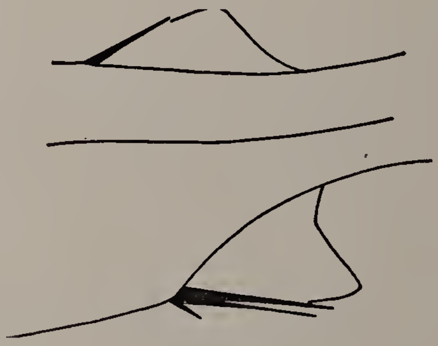
Dorsal fins 2—see 17.



17. Anal spines 1 or 2—the perch family, *Percidae.* Page 62.



Anal spines 3—the bass family, *Serranidae.* Page 60.



THE LAMPREY FAMILY—*Petromyzonidae*

Only one species in Nova Scotia.

Sea Lamprey—*Petromyzon marinus.* Linnaeus.

Other common names: Great Sea Lamprey; River, Green or Shad Lamprey; Lamper-eel; Lamprey-eel; Sucker; Nine-eyes; Lamper; Lake-Lamprey; Grosse Lamproie, Fifre; Oeillet, Lamproie marine.

RANGE: Both sides of the Atlantic, from northern Norway to West Africa on the East, and from Greenland to Florida on the West. Landlocked in the Great Lakes. Drainage.

OCCURRENCE IN NOVA SCOTIA: Anadromous in those streams such as the St. Mary's, Sackville, Annapolis, La Have, Shubenacadie, Musquodoboit, Mersey and Medway, which provide suitable gravelly spawning grounds and muddy flats for the maintenance of the larvae, but absent in others, such as the Margaree and Moser rivers, which do not.

Specimens in Nova Scotia Museum of Science collections from;

La Have River, Lunenburg Co., N. S. June 20, 1948.
Benery Brook, Enfield, Halifax Co., N. S. 1914.
Grand Lake, Halifax Co., N. S. 1912.

DESCRIPTION: The Lamprey feeds by attaching itself with its sucker-like mouth to other fishes, rasping away their skin and scales and sucking their blood. It has recently made its way through canals into the Great Lakes above Niagara, where it has become very plentiful and extremely destructive. Although the landlocked form is said to attack bathers in Lake Ontario, the lamprey fasts during the breeding-season, so no harm is to be expected from it while ascending Nova Scotia rivers to spawn.

In New England the Lamprey ascends streams to spawn from the end of March to early June. The spawning time in Nova Scotia is not known exactly, but dead lampreys have been washed down the La Have River, from June 15th to July 8th, indicating that spawning may occur later here.

The eggs are laid along stretches of stream where the bottom is stony or pebbly, in depressions two or three feet in diameter and about six inches deep excavated by both parents which die soon after spawning. The eggs develop into larvae which burrow in the mud and live on microscopic organisms suspended in the stream water. After a period believed to last from three to five years the larvae undergo transformation into the adult form and run to sea, where they spend an unknown length of time.

The length of lampreys at the time of transformation is from 100 to 200 mm. The sexually mature adults average about 2 to 2½ feet in length, with a maximum recorded size of about three feet.

REFERENCES: Bigelow, Henry B. & Schroeder, William C., 1948; Vladykov, Vadin D., 1949.

THE STURGEON FAMILY—*Acipenseridae*

Only one species in Nova Scotia.

American Sturgeon—*Acipenser oxyrynchus.* Mitchill.

OTHER COMMON NAMES: Common sturgeon, Sea Sturgeon, Esturgeon noir, Ecaille, Guinde, Escargot, Gang, Bâtard, Esturgeon, Esturgeon d'eau, Salêe, Pelican, River Sturgeon.

OCCURRENCE IN NOVA SCOTIA: Vladykov and McKenzie, in their paper on the marine fishes of Nova Scotia, say that it is rather common throughout the water surrounding Nova Scotia. It probably spawns in or above the estuaries of many of the larger streams.

There is one age-whitened specimen in the collections of the Nova Scotia Museum of Science, bearing the label "Jordan no. 41., *Acipenser sturio* L., Common sturgeon, Nova Scotia."

This specimen is the one depicted in Figure 2.

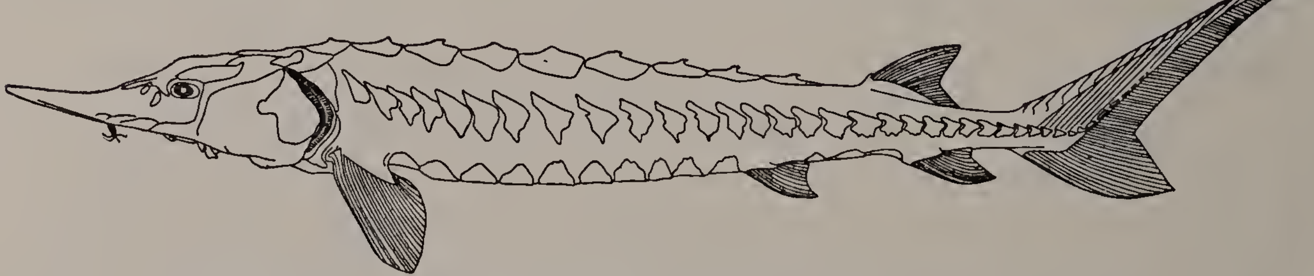


Figure 2. American Sturgeon—*Acipenser oxrynchus.*

DESCRIPTION: The American Sturgeon is one of the few survivors of a group of fishes that was dominant in early geological history. It feeds by straining food organisms out of the bottom material with its toothless mouth. Much of its time is spent in salt water, about the bays and near estuaries. Spawning occurs a short way up the rivers on hard bottom swept by a swift current. The spent fish return to sea, but the young remain in the rivers for at least a year. Large adults attain a weight of some 500 pounds and a length of 10 or more feet.

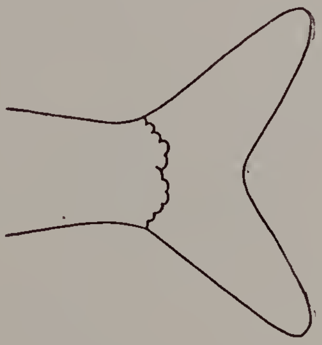
Where it abounds the Sturgeon is an important commercial fish, both for its flesh and for the caviar made from its roe, but in Nova Scotia the annual catch of 3,500 lbs. is of negligible importance, being valued at about $240.

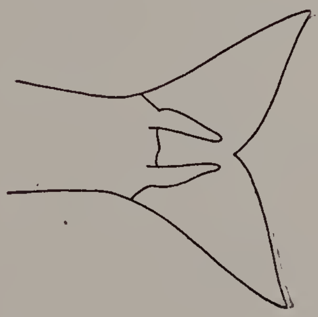
REFERENCES: Borodin, K. 1925.
Vladykov, V. D. and Gerald Bealieu, 1946.
Vladykov, V. D. and R. A. McKenzie 1935.

THE HERRING FAMILY—*Clupeidae.*

1. Two wing-like folds of skin present at base of caudal fin, each covered with one elongated scale; point of junction of lower jaw with skull under posterior edge of eye.

No wing-like folds with elongated scale at base of caudal fin; junction of lower jaw with skull under middle of eye. Pomolobus—see 2.





2. Diameter of eye about equal to length of snout; body about three and a half times as long as deep; peritoneal lining of belly black. Blueback, *Pomolobus aestivalis,* Mitchill. Page 20.

Diameter of eye greater than length of snout; body only about three times as long as deep; peritoneal lining of belly not so dark, in most individuals pale. Gaspereau, *Pomolobus pseudoharengus*, Wilson. Page 21.

Shad—*Alosa sapidissima.* Wilson.

Other common names: American Shad; Common Shad; Atlantic Shad; North River, Potomac, Connecticut River, Delaware, Susquehanna, etc., Shad.

Range: Atlantic Coast of America from the St. Lawrence to Alabama.

Occurrence in Nova Scotia: Vladykov and McKenzie say that the shad is "common throughout the whole region." It is probably anadromous in most, if not all, of the rivers of the province.

Specimens in Nova Scotia Museum of Science from the La Have River, Lunenburg County, N. S. June 20, 1948.

Description: The Shad spends most of its life in the sea but migrates up rivers in spring for the purpose of spawning Adults running upstream feed little if at all, but will sometimes strike at a fly, small minnow or other small shining objects when in fresh water. Though rather bony, the Shad is a delicious food dish. About 80,000 pounds, valued at $8,600. are caught annually.

This is one of the largest of the herrings, attaining a weight of some 5 or 10 pounds and a length of nearly 2 feet.

References: Vladykov, V. D. and McKenzie, R. A. 1935.
Leim, A. H. 1924.

Blueback—*Pomolobus aestivalis.* Mitchill.

Other common names: Glut herring; Summer Herring; Black-belly; Kyack; Saw-belly.

Range: Atlantic Coast of North America, more southerly than *Pomolobus pseudoharengus.*

Occurrence in Nova Scotia: The Blueback was listed for the Bay of Fundy by Huntsman in 1921, and, on his authority, by Vladykov and McKenzie in 1935. Dr. Huntsman is now of the opinion that *P. pseudoharengus* is the only species of *Pomolobus* in Nova Scotia (personal communication) and the present investigation completely confirms his revised opinion.

There is such a variation in the peritoneal color of *P. pseudoharengus* that some individuals would be placed in *P. aesrivalis* on the basis of this character alone, but examination of about a hundred specimens from Grand Lake and a smaller number from the La Have River has shown that the other characters are all those of *P. pseudoharengus*. It seems, then, that all the Nova Scotia gaspereaux belong to this species.

There are no specimens in the Nova Scotia Museum of Science collections.

REFERENCES: Vladykov, V. D. and McKenzie, R. A., 1935;
Leim, A. H., 1924.

Gaspereau—*Pomolobus pseudoharengus.* Wilson.

OTHER COMMON NAMES: Alewife; Ellwife; Branch Herring; Sawbelly; Wall-eyed Herring; Big-eyed Herring; Gray Herring; Blear-eyed Herring; Spring Herring; Golden Shad; Seth Green Shad; Skipjack; Bang; Mullhaden; Racer (spent fish).

RANGE: Atlantic Coast of United States and Canada; landlocked in the lakes of Western New York and in Lake Ontario; since 1931 in Lake Erie whence it has spread to Lake Huron.

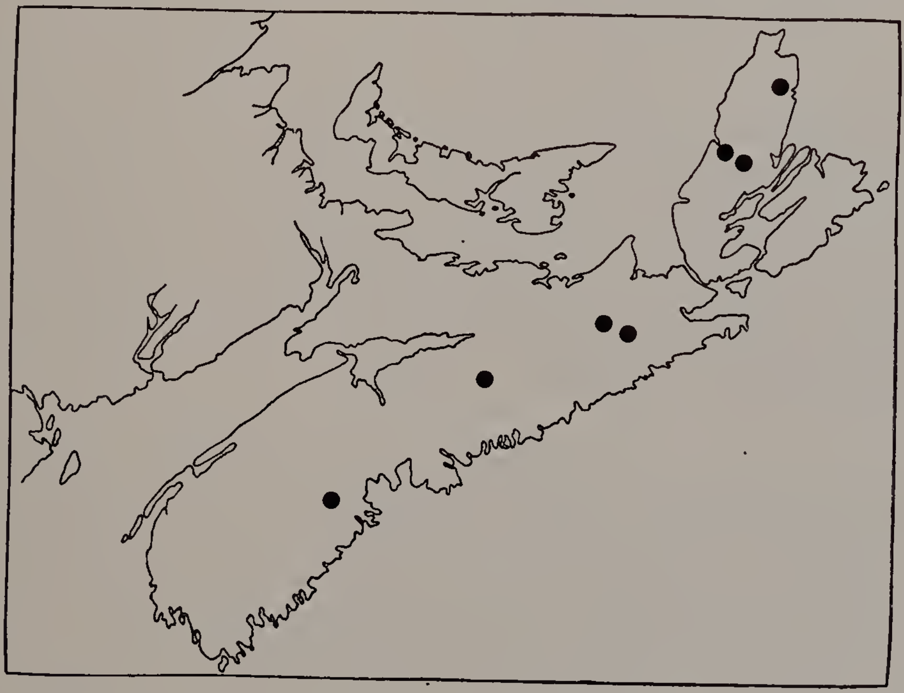


Figure 3. Distribution of Gaspereau—*Pomolobus pseudoharengus* in Nova Scotia.

Occurrence in Nova Scotia: Anadromous in streams throughout the province.

Specimens in the Nova Scotia Museum of Science collections from:

Goshen Lake, Guysborough Co., N. S.	August 3, 1948
Lake o' Law, Inverness Co., N. S.	September 8, 1948
2nd Indian Harbour Lake, Guys. Co., N. S.	August 1, 1948
Grand Lake, Halifax Co., N. S.	June 4, 1948
La Have River, Lunenburg Co., N. S.	June 20, 1948
Margaree River, Inverness Co., N. S.	August 20, 1948
Warren Lake, Victoria Co., N. S.	August 26, 1949

Description: In the spring spawning migration, the Gaspereau runs from the sea up the rivers where it is dipped out commercially and salted. It is very abundant, but because of its many small bones is not much esteemed, despite its excellent flavor. Adults weigh a little less than a pound.

The annual commercial catch of 2,150,000 pounds has a value of $30,000.

References: Gilpin, J. Bernard 1864.

THE SALMON FAMILY—*Salmonidae.*

1. Vomer flat, the teeth on its backward extension in one or two rows (sometimes lost with age) mostly black-spotted.—see 2. Vomer boat-shaped, the shaft depressed and without teeth on its backward extension; species with reddish or pale spots—see 4.
2. Anal usually with 9 fully-developed rays; caudal usually unspotted.—see 3. Anal with 10 or more fully-developed rays; caudal spotted. Rainbow Trout. *Salmo gairdneri*, Richardson. Page 23.
3. Vomerine teeth little developed, those on shaft few and deciduous; scales from adipose fin to lateral line 10 to 13; maxillary to below hind edge of pupil at 150 mm., never far behind in adult; caudal generally emarginate even in large adults; black spots on body small without halos. Atlantic Salmon, *Salmo salar*, Linnaeus. Page 23.
   Vomerine teeth well-developed; those on shaft of bone numerous and persistent; scales from adipose fin to lateral line 12 to 16;

mouth larger, maxillary to below hind edge of eye at 150 mm., farther back in larger specimens; caudal less emarginate, truncate in adults; black spots on body large,, many surrounded by halos. Brown trout, *Salmo trutta*, Linnaeus. Page 24.

4. Sides with light or pinkish spots, hyoid teeth present.—see 5.
Sides with red spots surrounded by blue borders; back vermiculated; hyoid teeth usually lacking. Eastern Speckled Trout, *Salvelinus fontinalis*, Mitchill. Page 25.

5. Tail deeply forked; back and sides with light-coloured spots. Lake Trout, *Cristivomer namaycush*, Walbaum. Page 26.
Tail less deeply forked; back uniformly coloured and sides with light-coloured spots. Alpine Char, *Salvelinus alpinus*, Linnaeus. Page 26.

Rainbow Trout—*Salmo gairdneri*. Richardson.

OTHER COMMON NAMES: McLeod Trout; Shasta Trout; Steelhead Trout.

RANGE: Native to western America, introduced widely elsewhere.

OCCURRENCE IN NOVA SCOTIA: Numerous attempts have been made to introduce this trout into Nova Scotia, but it appears to have established itself in few places, if any.

There are no specimens in the Nova Scotia Museum of Science collections.

Atlantic Salmon—*Salmo salar*. Linnaeus.

OTHER COMMON NAMES: Common Atlantic Salmon; Kennebec Salmon; Ouananiche (when landlocked in Quebec); Grayling (when landlocked in Nova Scotia;) Kelt or Slink (spent fish); Grilse, or Grilt, or Fiddler (small sea-run fish); Smolt (young running to sea;) Parr (young before running to sea); Saumon; Bratan.

RANGE: In the North Atlantic Ocean and ;during the spawning run and early life) in tributary streams. On the American side from southern Greenland and Labrador south, originally to the Hudson River and occasionally to the Delaware; at present to Maine.

OCCURRENCE IN NOVA SCOTIA: Anadromous in the rivers and smaller streams throughout the province. A landlocked form designated *Salmo salar sebago*, Girard, and known to anglers as Grayling occurs in Grand Lake and its tributary waters.

One specimen in the Nova Scotia Museum of Science collections from Lake Charlotte, Halifax Co., N. S., collected in the spring of 1950.

DESCRIPTION: Sea-run salmon get most of their growth in the sea, returning to fresh water to spawn. Unlike the various salmons of the Pacific Coast, the Atlantic Salmon returns to the sea after spawning, and may spawn more than once, but the proportion of fish actually doing so is very small.

The term "landlocked salmon" is rather unfortunate. There is no actual barrier to prevent *s. sebago* from running to sea from most of the lakes in which it occurs, and the opinion is widely held among biologists that the sea-run and the land-locked salmon are not genetically distinguishable.

REFERENCES: Kendall, W. C. 1935.

Brown Trout—*Salmo trutta*. Linnaeus.

OTHER COMMON NAMES: German Brown Trout, German Trout, German, English Brown Trout, Von Behr Trout, Loch Leven Trout, European Brown Trout, Truite, Breac, Gealag.

RANGE: Native to Europe and widely introduced into other regions.

OCCURRENCE IN NOVA SCOTIA: Introduced in several rivers. It is said to be rather abundant at Guysborough Inlet, where it is known as German Trout. Specimens up to 6 pounds are said to be taken on plugs in the tidewater of Guysborough Inlet.

There are no specimens in the Nova Scotia Museum of Science Collections.

The Brown Trout thrives in warmer water than the Brook Trout.

Eastern Speckled Trout—*Salvelinus fontinalis.* Mitchill.

Other common names: Eastern Brook Trout, Lake Trout; Sea Trout; Native Trout; Mountain Trout; Squaretailed trout or Squaretail; Truite; Brook Trout; Breac.

Range: From Labrador coastwise to Cape Cod, southward along the Appalachians to South Carolina and Georga, and in the interior to the Great Lakes basin, the Nelson River in Manitoba, and in a few far northern headquarters of the upper Mississippi River system; also in southeastern Minnesota and northeastern Iowa.

Occurrence in Nova Scotia: Probably the most widely distributed fish in Nova Scotia. Although collected seldom during the present study because of the methods used, it is taken by anglers throughout the province. It is found even on the plateau of northern Cape Breton, where no other fish seems to occur. Large numbers are distributed throughout the province annually by artificial stocking.

Specimens in N. S. Museum of Science collections from:

Copper Lake, Antigonish Co., N. S.	August 1948
Pembroke Lake, Inverness Co., N. S.	August 22, 1949
Warren Lake, Victoria Co., N. S.	August 26, 1949
Dalem Lake, Victoria Co., N. S.	August 29, 1949

Description: The Speckled Trout is found in clear cold lakes and streams. It prefers a temperature of from 45 —50 F. Some individuals run to sea where they assume a silvery appearance. Like the other members of the *Salmonidae* it is a fall spawner, laying its eggs on gravelly bottoms in the smaller streams. In Nova Scotia a 5 pound sea-run trout is a large one; land-locked specimens are smaller.

References: White, H. C. 1940.
Hayes, F. R. 1946.

Lake Trout—*Cristivomer namaycush.* Walbaum.

Other common names: Great Lakes Trout; Mackinaw Trout; Salmon Trout; Laker; Namaycush; Masamacush; Longue; Tague; Grey Trout; (N. S. Angling regulations); Great Gray Trout.

Range: From Alaska to Labrador south to northern New England, the northern margin of the Mississippi watershed and headwaters of the Columbia and Fraser Rivers. Widely introduced in lakes of the Western United States.

Occurrence in Nova Scotia: Various deep-water lakes in Halifax, Lunenburg, Shelburne, Annapolis and Kings Counties. It has been believed that the Lake Trout is not native to Nova Scotia, for Lanman in 1872 expressed doubt of its existence in the Province. However Gilpin in 1866 recorded it from several lakes in Nova Scotia under the name of *Salmo Confinis* (DeKay). It seems unlikely that *C. namaycush* was artificially introduced into Nova Scotia before that time.

Specimens in the Nova Scotia Museum of Science collections from:—

Pockwock Lake, Halifax Co., N. S.	June 1900
Nine Mile Lake, Lunenburg Co., N. S.	1902
Nine Mile Lake, Lunenburg Co., N. S.	1903
Dollar Lake, Halifax Co., N. S.	1908

Description: The Lake Trout is distinctly a deep-water fish, seldom occurring in lakes less than 40 feet deep. It apwans in the fall on reefs and shoals in the lakes where it is found. Thus it is less migratory than our other salmonids, which tend to wander away from their parent breeding grounds during most of their lives, returning only to spawn.

In the Great Lakes this fish grows to 100 pounds, but in Nova Scotia it probably does not exceed 25 pounds.

Alpine char—*Salvelinus alpinus.* Linnaeus.

Other common names: Hearne's Salmon.

Range: Anadromous in streams of Gulf of St. Lawrence (rare) coast of Labrador, northern coast of Canada and of islands to the north; in streams entering Hudson Bay, but not James Bay.

Occurrence in Nova Scotia: This fish is not known to occur in Nova Scotia, but as it has been found in cold New Brunswick lakes, it may be found at some time in the future. in the waters of this province which flow into the Gulf of St. Lawrence.

There are no specimens in the Nova Scotia Museum of Science collections.

THE WHITEFISH FAMILY—*Coregonidae*

A single flap between nostrils; body subterete.

Round Whitefish—*Prosopium cylindraceum quadrilaterale,* Richardson. Page 27

Two flaps between nostrils; body somewhat compressed.

Common Whitefish—*Coregonus clupeaformis*, Mitchill. Page 28

Round Whitefish—*Prosopium cylindraceum quadrilaterale.* Richardson.

Range: Northern North America from the Arctic Ocean south through lakes and streams of Eastern Canada to the Great Lakes and New England. Probably also in the Bering Sea drainage of Siberia.

Occurrence in Nova Scotia: Recorded only once, from the mouth of the Sissibou River, St. Mary's Bay, Digby County, in 1919, by Huntsman.

There are no specimens in the Nova Scotia Museum of Science collections.

The usual size entering the catch in the Great Lakes is about 2 pounds.

References: Vladykov, V. D. and McKenzie, R. A. 1935

Common Whitefish—*Coregonus clupeaformis.* Mitchill.

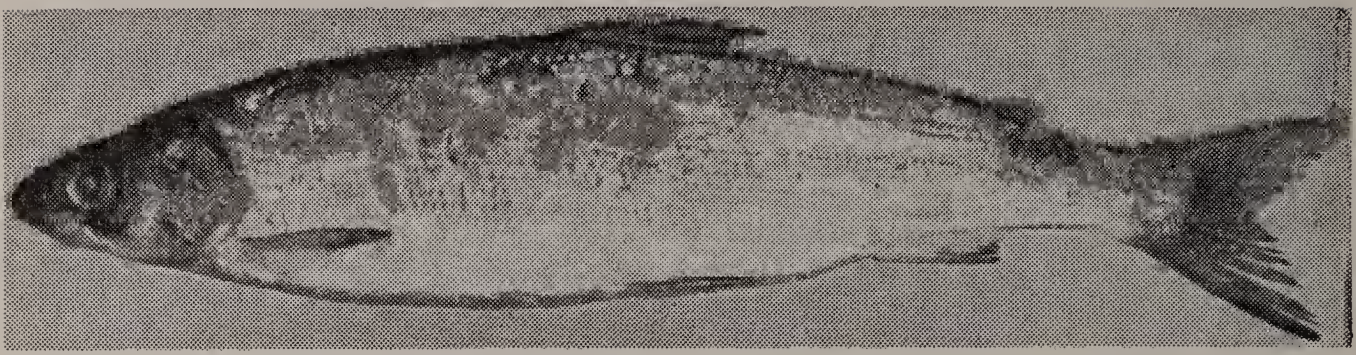


Figure 4. Whitefish—*Coregonus clupeaformis.*

OTHFR COMMON NAMES: Sault Whitefish; Bass.

RANGE: From Nova Scotia and northern New Brunswick, throughout Canada to the Northwest Territories and the Yukon; south to New England, New York, Michigan and Wisconsin.

OCCURRENCE IN NOVA SCOTIA: Dymond mentions this whitefish from Lunenburg and Yarmouth counties, possibly introduced. In Lunenburg County it occurs in several lakes at the headwater of the Petite Riviere, whence it was first recorded by Piers in 1924. From Yarmouth county it has been recorded only once, from Yarmouth Harbour.

Specimens in the Nova Scotia Museum of Science Collections from:—

Leipsigate Lake, Lunenburg Co., N. S.	1923
Leipsigate Lake, Lunenburg Co., N. S.	June 5, 1950

DESCRIPTION: Little is known about the habits of the Whitefish in Nova Scotia, but it is a fall spawner elsewhere, broadcasting its eggs on the bottom in shoal areas. Although the supply is seriously depleted at present the Whitefish is still the most valuable food fish in the Great Lakes. The average size taken there by commercial fishermen is about 22 inches and 3½ pounds, but the Nova Scotian fish are much smaller than this, seldom if ever exceeding 18 inches, and usually weighing only a little over 1 pound.

The Whitefish can be taken in streams by the methods used is catch the Speckled Trout, and it is occasionally taken while trolling in lakes as well.

REFERENCES: Piers, Harry 1924.
Lanman, C. 1872.

THE SMELT FAMILY—*Osmeridae*

Only one species in Nova Scotia.

American Smelt—*Osmerus mordax.* Mitchill.

OTHER COMMON NAMES: Smelt, leefish.

RANGE: Anadromous in the streams of the Atlantic coast from Virginia to the Maritime Provinces. A naturally permanent resident in many large fresh-water lakes, and an introduced permanent resident in all of the Great Lakes.

OCCURRENCE IN NOVA SCOTIA: Probably spawning in streams throughout the province. A permanent resident in Centreville Lake, Digby County, Copper Lake, Antigonish Co., (introduced) and probably elsewhere.

Specimens in Nova Scotia Museum of Science from:

Grand Lake, Hants Co., N. S.	1930
Dauphinee Mill Lake, near Hubbards, Lunenburg Co., N. S.	1936
Sailors' Lake, Hubbards Halifax Co., N. S.	1934
Copper Lake, Antigonish Co., N. S.	August 1948
Centreville Lake, Digby Neck, Digby Co., N. S.	July 28 1499

DESCRIPTION: Sea run Smelt move into estuaries from the open sea each autumn and remain there during the winter. After the spring break-up they run into the coastal streams and spawn in the fresh and brackish water.

The Land-locked Smelt is a fish of cold waters, usually found at depths greater than 40 feet during the summer. In the Great Lakes, it attains a length of about 14 inches, as compared to 10 for the sea-run smelt, but probably all Nova Scotia Land-locked Smelt are smaller than this.

The Smelt is a fish of considerable commercial importance. The annual catch of about 800,000 pounds is valued at $115,000.

REFERENCES: Van Ossten, John 1940.
McKenxie, R. A. and Day, L. R.

THE SUCKER FAMILY—*Catostomidae.*

1. Lateral line well developed; greatest depth less than one-fifth standard length.—see .
   Lateral line absent; greatest depth more than one-fifth standard length. Creek Chubsucker, *Erimyzon oblongus oblongus.* Mitchill. Page 30.
2. Scales fewer than 80 in lateral line. Common White Sucker, *Catostomus commersoni commersoni,* Lecepede. Page 30.
   Scales more than 85 in lateral line. Northern Sucker, *Catostomus catostomus catostomus.* Forster. Page 33.

Creek Chubsucker—*Erimyzon oblongus oblongus.* Mitchill

RANGE: Atlantic Coast drainage from Nova Scotia and New Brunswick (and possably from the St. Lawrence River) to Virginia. In the Great Lakes confined to the eastern part of the Lake Ontario basin.

OCCURRENCE IN NOVA SCOTIA: Listed as *Erimyzon sucetta* by Jones in his "List of the Fishes of Nova Scotia," 1879. He gave no information on collection locality, and the species has not been collected since his time, if ever, so it seems probable that it does not occur in the province.

There are no specimens in the Nova Scotia Museum of Science collections.

Common White Sucker—*Catostomus commersonni commersonni.* Lacèpêde

OTHER COMMON NAMES: Sucker; White, Brook, Mud, Black, June or Fine-scaled Sucker; Fine-scaled Mullet; Bay Mare; Black Mullet; Truitu.

RANGE: North America east of the Great Plains, from the MacKenzie River in northern Canada to the Hudson Bay drainage and to the Labrador Peninsula; south on both sides of the Appalachians to Georgia and to Arkansas and northeastern Oklahoma.

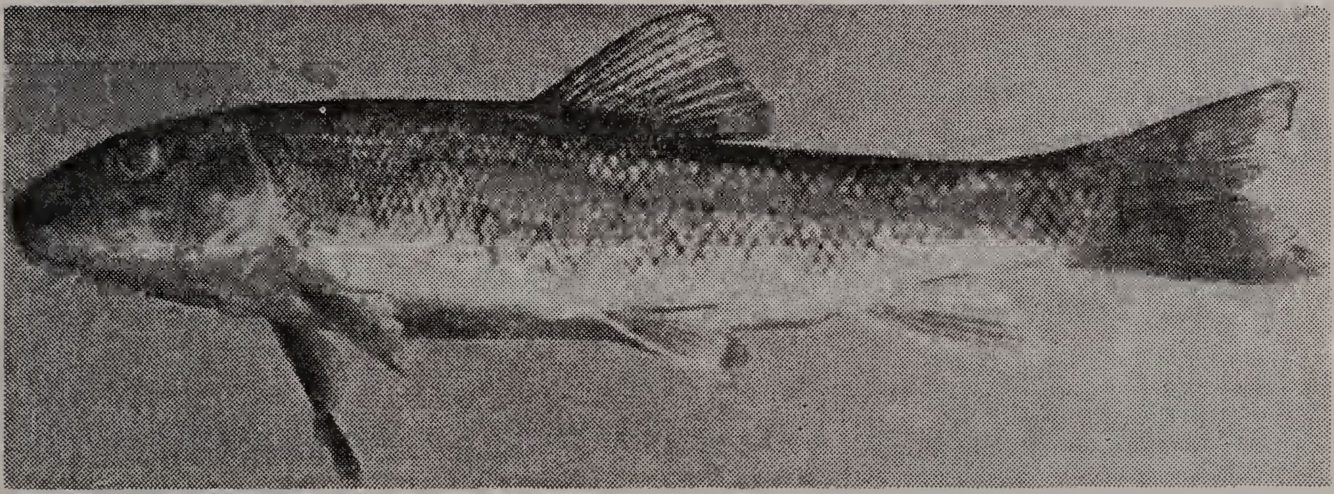


Figure 5. Common White Sucker—*Catostomus c. Commersonni.*
2/3 life size.

Occurrence in Nova Scotia: One of the commonest fishes throughout the province. It occurs in some lakes and streams, but not all, in every region except the plateau of northern Cape Breton. It is more common in the soft rock areas than in the granite areas.

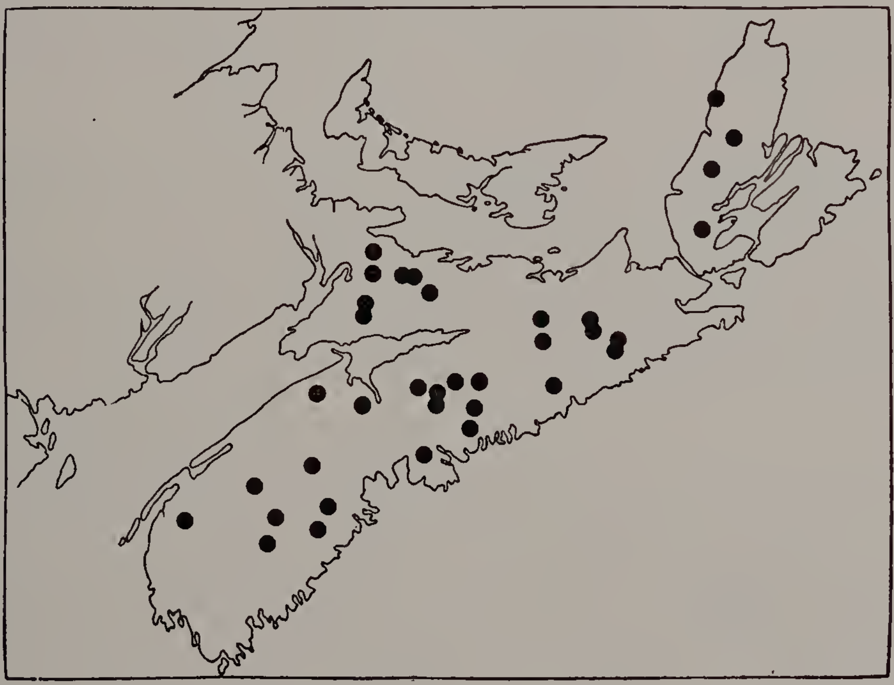


Figure 6: Distribution of Common White Sucker in Nova Scotia.

Specimens in the Nova Scotia Museum of Science from:—

Sherbrooke Lake, Lunenburg Co., N. S.		1946
Gully Brook, Lunenburg Co., N. S.		1946
Black Brook Lake, Pictou Co., N. S.	August	1946

Meteghan River, Digby Co., N. S.	July 27, 1949
Mulgrave Lake, Annapolis Co., N. S.	July 6, 1949
Goshen Lake, Guysborough Co., N. S.	August 3, 1948
St. Mary's River, Guysborough Co., N. S.	August 3, 1948
Lake o' Law, Inverness Co., N. S.	September 8, 1948
La Have River, Lunenburg Co., N. S.	June 19, 1948
Sherbrooke Brook, Guysborough Co., N. S.	August 2, 1948
Lake Ainslie, Inverness Co., N. S.	September 9, 1948
Copper Lake, Antigonish Co., N. S.	August, 1948
River Inhabitants, Inverness Co., N. S.	September 5, 1948
Fullerton Lake, Cumberland Co., N. S.	September 25, 1948
Gilbert Lake, Cumberland Co., N. S.	September 24, 1948
Grand Lake, Halifax Co., N. S.	June 6, 1948
Liverpool River, Annapolis Co., N. S.	July 6, 1949
Mink Lake Brook, Annapolis Co., N. S.	July 6, 1949
Tributary of the Musquodoboit River, Halifax Co.	June 12, 1949
Whiteburn Brook, Queens Co., N. S.	July 1, 1949
Whiteburn Brook, Queen Co., N. S.	July 2, 1949
Le Grand Lac, Grand Etang. Inverness Co., N. S.	August 22, 1949
Little Lake, Grand Lake, Colchester Co., N. S.	September 1, 1949
Ninamkeak Lake, Lunenburg Co., N. S.	June 4, 1950
Nine-Mile River, St. Margaret's Bay Rd., Halifax Co.	1918
Porter's Lake, Halifax Co., N. S.	1900
Elmsdale, Shubenacadie River, Halifax-Hants Co.	1919
Grant Brook, Hants Co., N. S.	June 12, 1949
Small Brook, near 3-mile Plain, Hants Co., N. S.	July 13, 1950
East River, Sheet Harbour, Halifax Co., N. S.	July 18, 1950
Small Lake near Lorne, Pictou Co., N. S.	July 19, 1950
Ponds near Cornwallis River, Kings Co., N. S.	May 31, 1950

DESCRIPTION: The Common White Sucker spawns in spring in swift water with a gravel bottom. It feeds upon small molluscs, insect larvae and crustaceans by browsing along the bottom, straining food organisms from the mud with its mouth. Although it is said to attain a weight of 5 pounds, specimens of over 1 pound are very unusual, at least in Nova Scotia, and many waters do not seem to contain individuals of more than 4 or 5 inches length, at which size they are quite mature.

REFERENCES: Adams and Hankinson 1928.

Eastern Sturgeon Sucker—*Catostomus catostomus catostomus.* Forster.

Other common names: Northern Sucker, Long-nosed, Red, Red-Striped, Sturgeon, Fine-scaled or Black Sucker.

Range: From the Yana River in Asia to Labrador, south to the northern Rocky Mountains, the northern part of the Mississippi River system in Minnesota, the southern part of the Great Lakes basin, the Youghiogheny River in Pennsylvania, the St. Lawrence River system and northeastern New England.

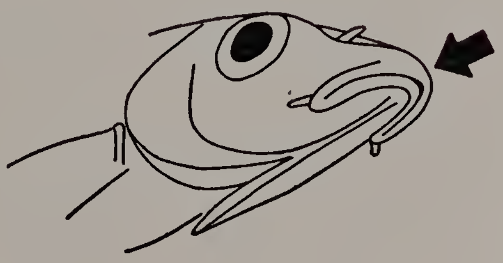
Occurrence in Nova Scotia: This species has never been recorded from Nova Scotia. It is included here only because it occurs in New Brunswick, and may perhaps be found in this province at some later date.

There are no specimens in the Nova Scotia Museum of Science.

This sucker commonly attains a length of 2 feet.

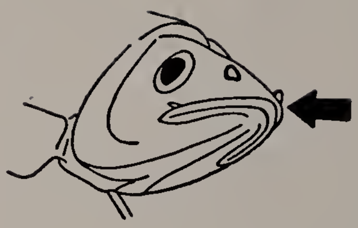
THE MINNOW FAMILY—*Cyprinidae.*

1. Premaxillaries nonprotractile (upper lip connected to snout by a bridge of tissue across which the premaxillary groove does not pass.) Eastern Blacknose Dace, *Rhinichthys atratulus atratulus*, Hermann, Page 35

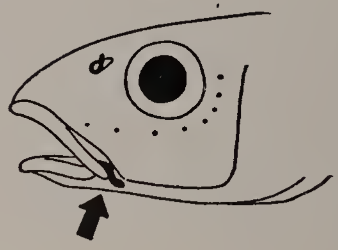


Premaxillaries protractile (upper lip separated from snout by a deep groove continuous across the midline)—see 2.

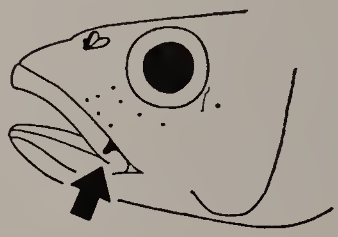
2. Maxillary with a barbel which is usually inconspicious and often hidden in the groove about the upper jaw—see 3.
Maxillary without a barbel—see 6.



3. Barbel at or near end of maxillary—Lake Northern Club, *Couesius plumbeus plumbeus*, Agassiz. Page 35.



Barbel well in advance of posterior end of maxillary—see 4.



4. Scales less than 50 in lateral line—Fallfish, *Leucosomus corporalis*, Mitchill. Page 37.
Scales more than 50 in lateral line—see 5.

5. Black spot at base of dorsal fin—Northern Creek Club, *Semotilus atromaculatus atromaculatus*, Mitchill. Page 37.
No black spot at base of dorsal fin—Northern Pearl Dace, *Margariscus margarita nachtriebi*, Cox. Page 40.

6. Scales more than 60 in lateral line—see 7.
Scales fewer than 55 in lateral line—see 9.

7. Intestine short with only one loop—see 8.
Intestine long, with a loop and two crosswise coils—Northern Redbelly Dace, *Chrosomus eos*, Cope. Page 41.

8. Peritoneum black—Finescale Dace, *Pfrille neogaea*, Cope. Page 43.
Peritoneum pale—Northern Pearl Dace, *Margariscus margarita nachtriebi*, Cox. Page 40.

9. Abdomen behind pelvic fins with a fleshy keel over which the scales do not pass. Eastern Golden Shiner, *Notemigonus crysoleucas*, Mitchill. Page 43.
Abdomen behind pelvic fins rounded over and scaled—see 10.

10. With a well-developed black lateral band which extends forward to the tip of the snout. Northern Blacknose Shiner, *Notropis heterolepis heterlepis*, Eigenmann. Page 46.
Lateral band not pronounced, not extending to snout—Common Shiner, *Notropis cornutus*, Mitchill. Page 47.

Eastern Blacknose Dace—*Rhinichthys atratulus atratulus.* Hermann.

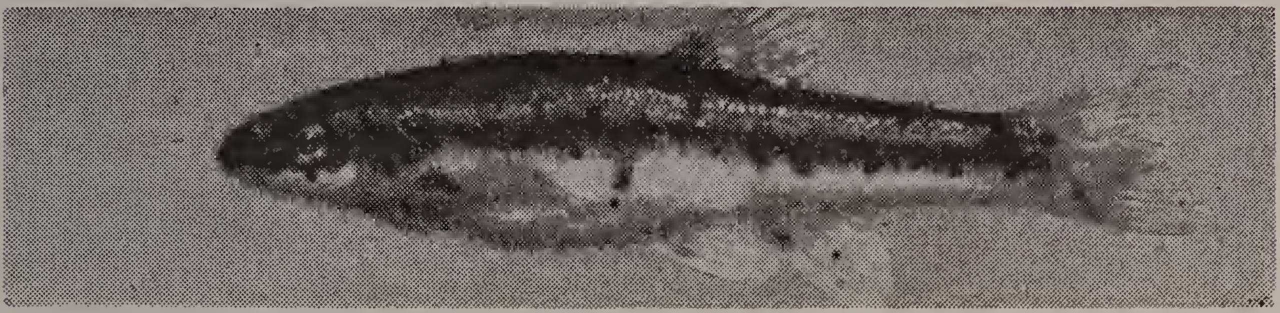


Figure 7. Eastern Blacknose Dace,—*Rhinichthys a. atratulus.* Life Size.

Other common names: Dace; Striped or Redfin Dace; Brook Minnow; Potbelly; Pottlebelly;

Range: From Nova Scotia through the St. Lawrence and lower Great Lakes region, north to Lake Simco and Grey County, Ontario; southward, east of the Appalachian Divide, to the Roanoke watershed in Virginia (known on the western slope only in the headwaters of the Youghiogheny in West Virginia.)

Occurrence in Nova Scotia: This species is known to occur only in Cumberland County.

Specimens in Nova Scotia Museum of Science collections from:—

Branch of Shinimicas River, Cumberland Co., N. S.	August 23, 1950
River Phillip, Cumberland Co., N. S.	August 23, 1950

Description: This small minnow, reaching a length of some 3 inches, is here recorded for the first time from Nova Scotia.

Lake Northern Chub—*Couesius plumbeus plumbeus.* Agassiz

Other common names: Chub Minnow; Plumbeus Minnow; Moose Lake Minnow.

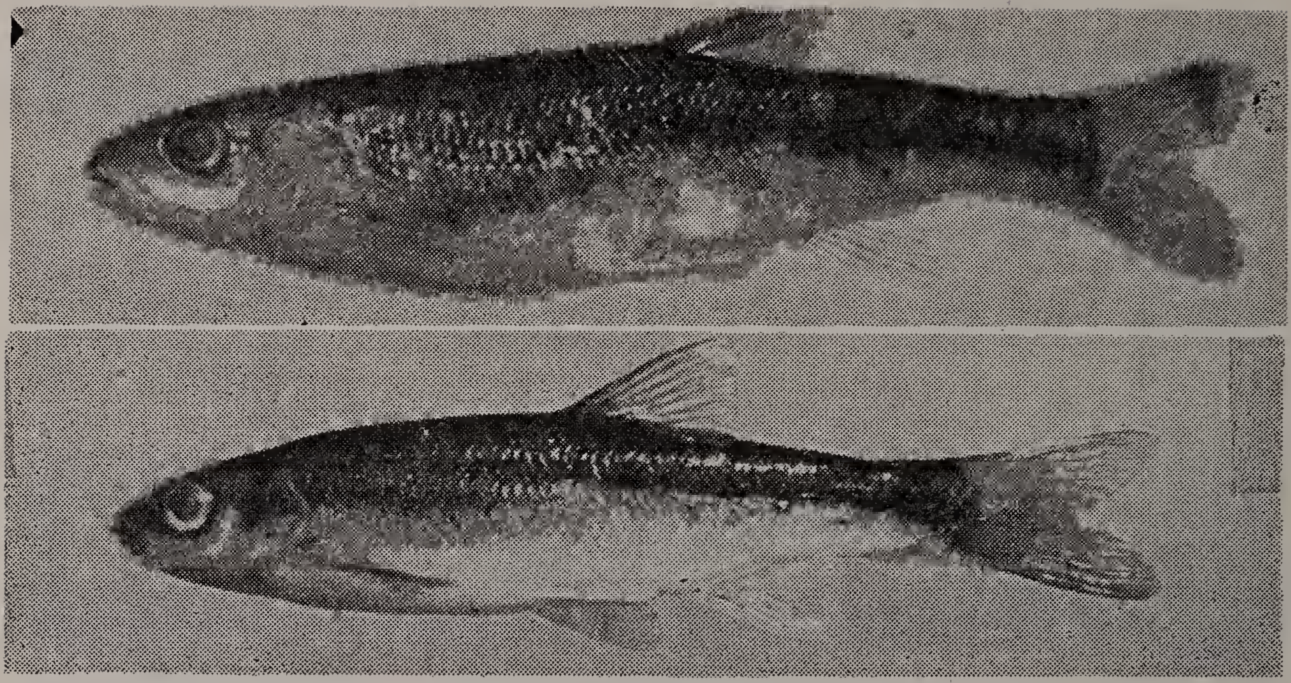


Figure 8. Lake Northern Chubb—*Couesius p. plumbeus.*

Range: Nova Scotia to the MacKenzie River: south to the Great Lakes (except Lake Erie) and northern New England.

Occurrence in Nova Scotia: Occasional throughout the mainland of the province from Moser River, Halifax County to Bear River, Annapolis County. Although this subspecies is characteristic of lakes over most of its range it is commonly found in streams in Nova Scotia.

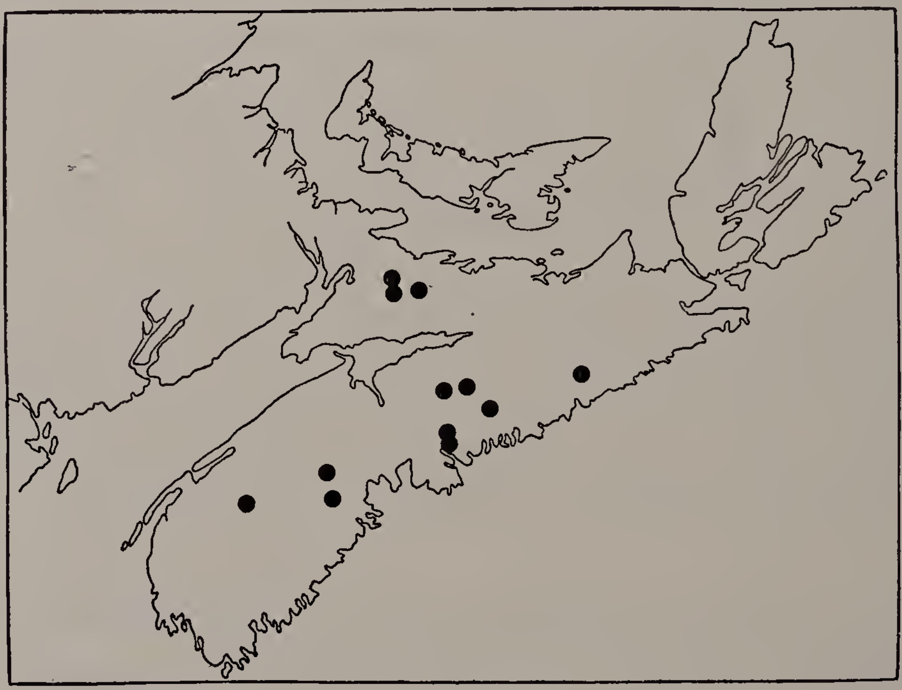


Figure 9. Distribution of Lake Northern Chub, *Couesius p. plumbeus* in Nova Scotia.

Specimens in the Nova Scotia Museum of Science Collections from:

La Have River, Lunenburg Co., N. S.	June 19, 1948
Grant Brook, Hants Co., N. S.	June 12, 1949
La Have River, Lunenburg Co., N. S.	June 20, 1948
Shubenacadie River, Enfield, Halifax-Hants Co.	1948
Penhorn Lake, West of Dartmouth, Halifax Co.	1910
Mink Lake Brook, Annapolis Co., N. S.	July 6, 1949

DESCRIPTION: There appears to be an almost complete lack of published information concerning the life history of *Couesius plumbeus*, Some information should be forthcoming shortly however, as Vernon C. Applegate is currently investigating the subject in Michigan.

Couesius p. plumbeus grows to a length of about 6 inches.

Fallfish—*Leucosomus corporalis.* Mitchill

OTHER COMMON NAMES: American Chub; Mohawk, White; Silver or Rough-nosed Chub; Dace; Windfish; Corporal; Chivin; Whiting.

RANGE: From northern tributaries of James Bay to New Brunswick, northern tributaries of the St. Lawrence River and eastern drainages of Lake Ontario, southward, east of the Appalachians, to Virginia.

OCCURRENCE IN NOVA SCOTIA: Not known from Nova Scotia as yet, but it may possibly be found here at some later date.

There are no specimens in the Nova Scotia Museum of Science collections.

DESCRIPTION: The Fallfish is a large minnow. Although it usually matures at a much smaller size occasional individuals are said to exceed 12 inches under favourable conditions.

Northern Creek Chub—*Semotilus atromaculatus atromaculatus.* Mitchill

OTHER COMMON NAMES: Chub: Brook, Silver, Mud, Black-spot Chub; Horned Dace; Tommycod.

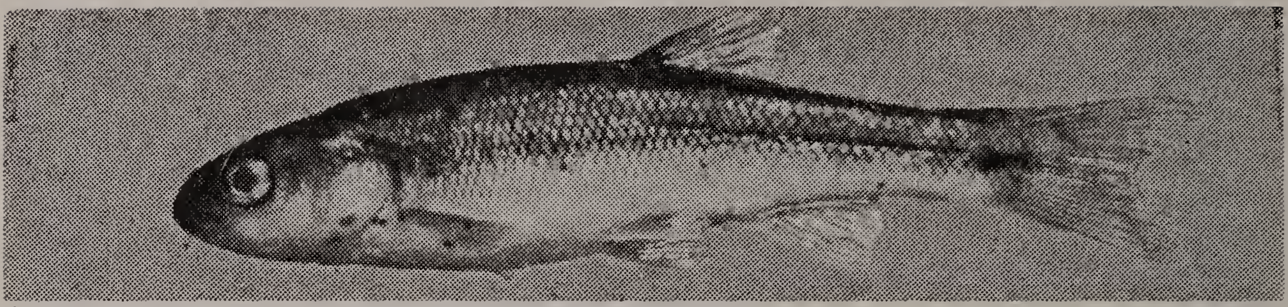


Figure 10. Northern Creek Chub—*Semotilus atromaculatus atromaculatus.*

RANGE: From Montana and from the Red River of the North Drainage, north to the north shore of Lake Huron, east to Nova Scotia, southward on both sides of the Appalachians to Georgia and other Gulf States, southwesterly to the Ozark Upland and to the Arkansas and upper Pecos river systems in New Mexico.

OCCURRENCE IN NOVA SCOTIA: Except for *Notemigonus crysoleucas*, the most widely distributed minnow in the province. It occurs in some, but not all, lakes and streams everywhere except on the plateau of northern Cape Breton.

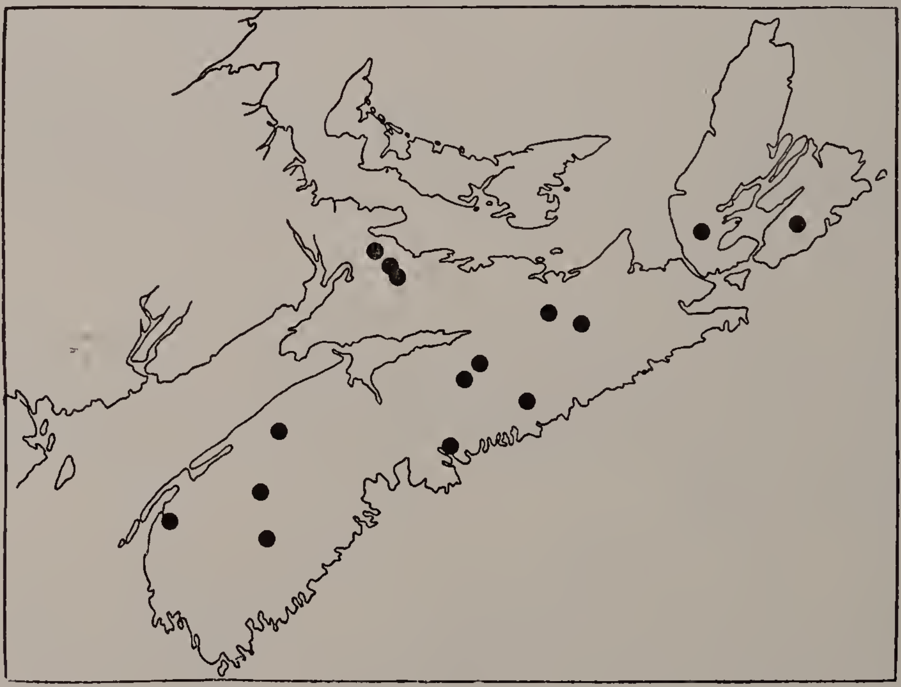


Figure 11. Distribution of Northern Creek Chub—*Semotilus a. atromaculatus* in Nova Scotia.

Specimens in Nova Scotia Museum of Science collections from:

Copper Lake, Antigonish Co., N. S. . . . . June 28, 1946
Elliott Lake, Annapolis Co., N. S. . . . . July 11, 1946

Black Brook Lake, Pictou Co., N. S.	August 1946
Meteghan River, Digby Co., N. S.	July 27, 1949
River Inhabitants, Inverness Co., N. S.	September 5, 1948
Loch Lomond, Cape Breton Co., N. S.	September 26, 1948
Copper Lake, Antigonish Co., N. S.	August 2, 1948
Grant Brook, Hants Co., N. S.	June 11, 1949
Whiteburn Brook, Queens Co., N. S.	July 1, 1949
Whiteburn Brook, Queens Co., N. S.	July 2, 1949
Nictaux River, near Middleton, Annapolis Co., N. S.	1910
Shubenacadie River, Milford, Halifax-Hants Co.	1919
Big Dam Lake, Annapolis Co., N. S.	July 5, 1949
Grant Brook, Hants Co., N. S.	June 12, 1949

DESCRIPTION: The Creek Chub is believed by some to be a serious competitor of the speckled trout, because it eats the same sort of food—insects, crustaceans, molluscs, small fish and so forth. In actual fact too little evidence is available to arrive at a reliable conclusion concerning the relation of chub to trout.

The breeding habits of the Creek Chub are somewhat similar to those of the Common Shiner, the eggs being laid in a gravel nest, usually at the head of rapids. The peculiar form of animal behavior known as deferred combat has been well described for the Creek Chub by Reighard. When a strange male approaches the side of the nest, he is joined by the guarding male, whereupon the two fish "swim upstream with great deliberation for a distance of 15 to 20 feet . . . In their course they move slowly and swing their tails from side to side in unison, as though keeping step with them. At the end of their course, they settle to the bottom and bring their heads and their tails together, as though about to swim away from one another. They then commonly again bring their heads together, and finally separate, the owner to return to his nest, his companion to some near-by shelter."

This is one of our largest minnows. In some places it reaches a total length of 12 inches at an age of seven winters for the male and 11 inches at six winters for the female. Although Perly, in his catalogue of the fishes of Nova Scotia and New Brunswick, gave a maximum size of over 3 pounds for the Creek Chub, it is very unlikely that such a size is attained anywhere, let alone in Nova Scotia.

REFERENCES: Reighard, Jacob 1910.
Hubbs, Carl L. and Cooper, Gerald P. 1936.

Northern Pearl Dace—*Margariscus margarita nachtriebi.* Cox.

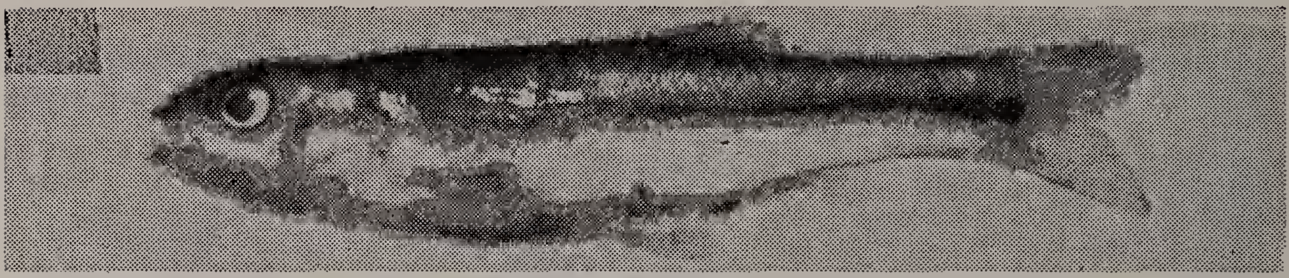


Figure 12. Northern Pearl Dace—*Margariscus margarita nachtriebi.* 7/8 Life Size.

RANGE: From Nova Scotia nearly to the Rocky Mountains; in Ontario north to Lake Nipigon; south to Maine, Lake Champlain and some tributaries of Lake Ontario in New York; west to the Dakotas and as rare relicts in the Sand Hills of Nebraska.

OCCURRENCE IN NOVA SCOTIA: Known only from Lake Ainslie and the Margaree drainage on Cape Breton Island, from a small lake in Pictou Co., and doubtfully from the Shinimicas River in Cumberland Co. but probably common in the drainages emptying into Northumberland Strait and the Gulf of St. Lawrence.

Specimens in Nova Scotia Museum of Science collections from:

Lake Ainslie, Inverness Co., N. S.	September 9, 1948
Small lake near Lorne, Pictou Co., N. S.	July 19, 1950
Shinimicas River, Cumberland Co., N. S.	August 23, 1950

DESCRIPTION: The food and growth of the Northern Pearl Dace are not well investigated. Its large mouth, however, suggests that it is largely carnivorous, feeding upon such small animals of all kinds as come its way. Langlois has described the breeding habits of this fish. He found that it spawns in streams, where it does not build a nest, but does guard its spawning area against intruders.

In Nova Scotia *Margariscus* grows to at least 5 inches.

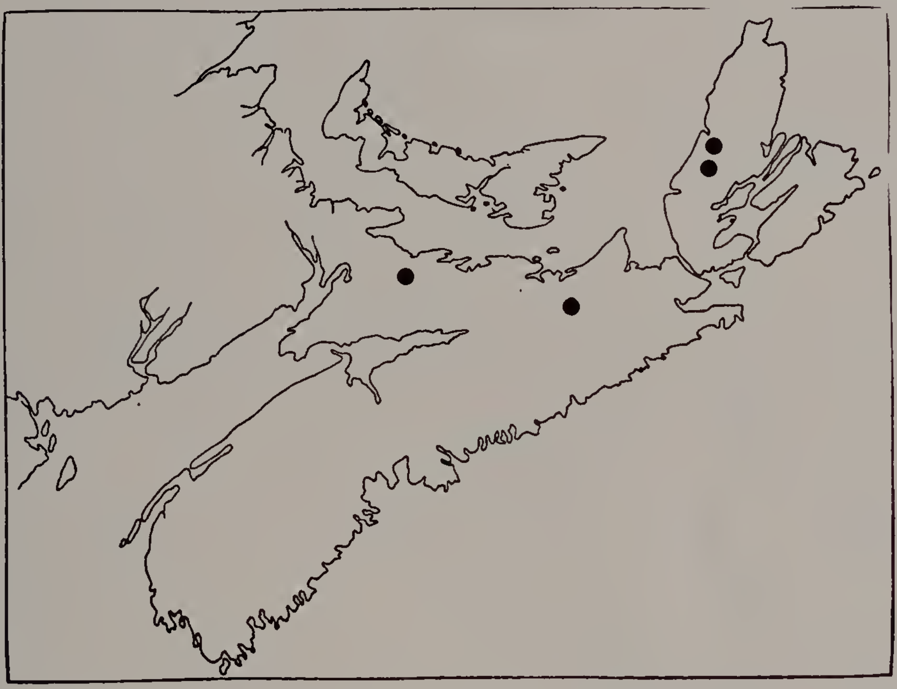


Figure 13. Distribution of Northern Pearl Dace—*Margariscus margarita nachtriebi* in Nova Scotia.

References: Langlois, T. H. 1929.

NORTHERN REDBELLY DACE—*Chrosomus eos.* Cope

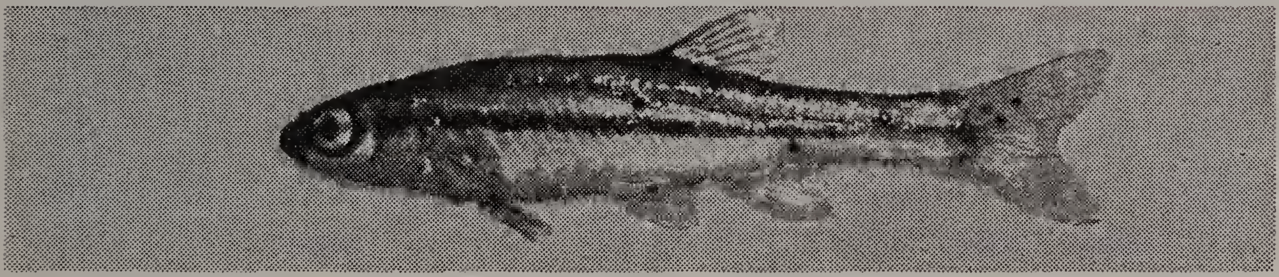


Figure 14. Northern Redbelly Dace—*Chrosomus eos.* Cope. 7/8 Life Size.

Range: From Nova Scotia to northern British Columbia south to Maryland, Wisconsin and Colorado

Occurrence in Nova Scotia: From Windsor, Hants County to Lake Ainslie on Cape Breton Island.

Specimens in Nova Scotia Museum of Science from:—

Shubenacadie River, Halifax-Hants Co., N. S.		1919
Little Lake, Grand Lake, Hants Co., N. S.	Sept.	1, 1949

Small Lake on Windsor Road, near St. Croix, Hants Co., N. S.	July	13, 1950
Cameron Lake, Hants Co., N. S.	July	13, 1950
Small Lake near Lorne, Pictou Co., N. S.	July	19, 1950
Ponds by Cornwallis River, west of bird sanctuary, Kings Co., N. S.	May	31, 1950

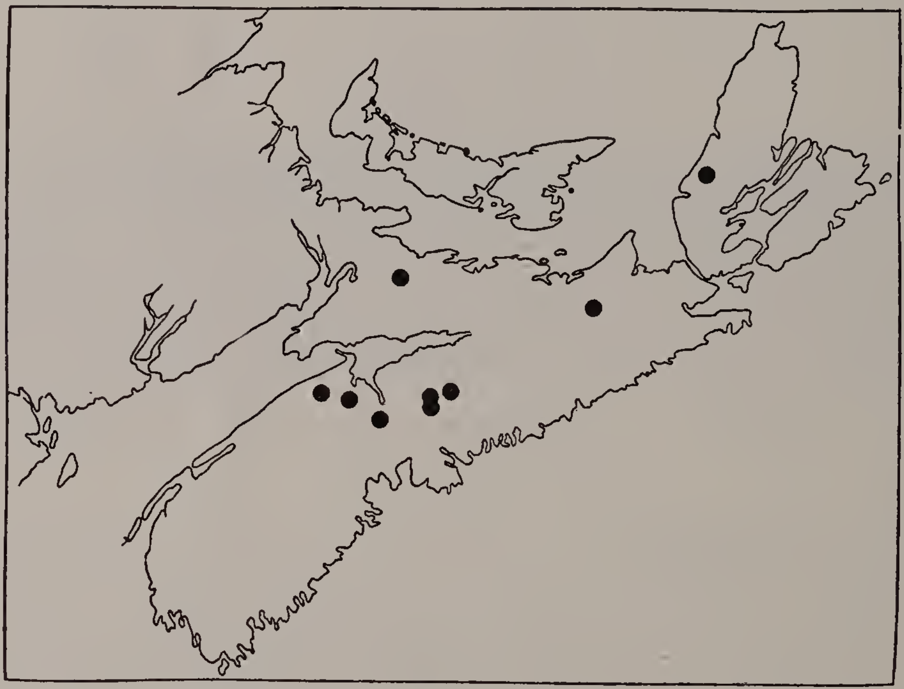


Figure 15. Distribution of Northern Redbelly Dace—*Chrosomus eos* in Nova Scotia. Cope.

Description: The Northern Redbelly Dace is a small minnow, reaching a length of only about 2½ inches. It gets its name from the brilliant colours of the male during the breeding season, which extends from May to August in Michigan. Though it seems to prefer boggy waters, this fish is absent from most of the bg lakes and streams of Nova Scotia. This is probably due to incomplete dispersal rather than unsuitability of the waters from which it is absent.

The food of this Dace consists mostly of plants, such as algae and the remains of seed plants, although some insects and animal plankton are also eaten. This diet, combined with its small size, has led to the suggestion that *Chrosomus eos* might be an excellent forage fish for trout and deserves stocking for that reason.

References: Hubbs, Carl L. and Cooper, Gerald P. 1934.

Finescale Dace—*Pfrille neogaea.* Cope.

Other common names: Bronz Minnow.

Range: New Brunswick to Northwest Territories, south to Maine, New Hampshire, New York, southern Ontario, southern part of Michigan and Wisconsin, northern Minnesota; glacial relict populations in the Black Hills of South Dakota and the Sand Hills of Nebraska.

Occurrence in Nova Scotia: Though not known to occur in Nova Scotia, the Finescale Dace may be found here at some future time.

There are no specimens in the Nova Scotia Museum of Science collections.

The Finescale Dace is characteristic of boggy waters.

Eastern Golden Shiner—*Notemigonus crysoleucas crysoleucas* Mitchill

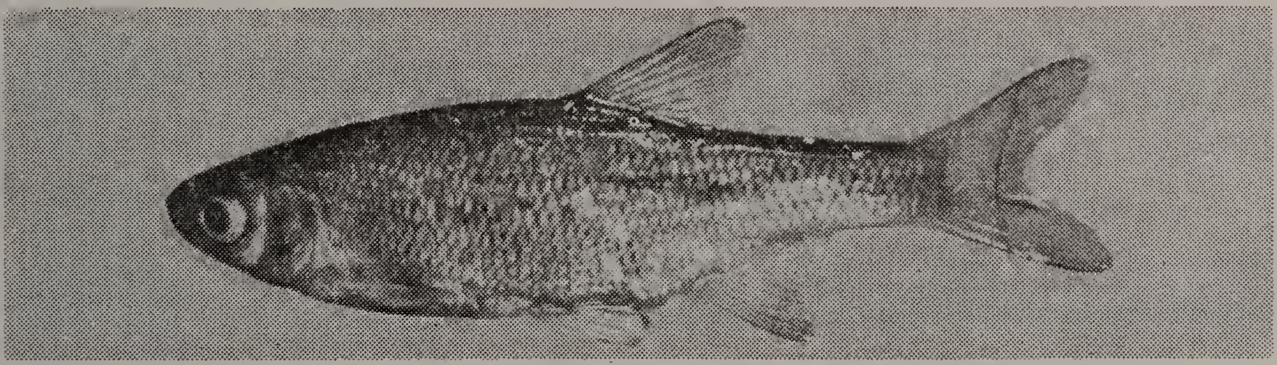


Figure 16a. Eastern Golden Shiner—*Notemigonus c. crysoleucas.* Life Size. Adult

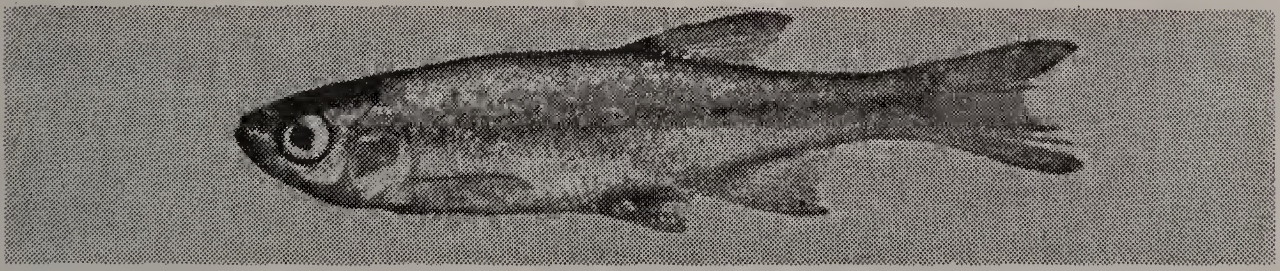


Figure 16b. Eastern Golden Shiner—*Notemigonus c. crysoleucas.* Life Size. Juvenile

OTHER COMMON NAMES: Roach; Shiner; American Roach; American Bream; Bream; Sunfish; Dace; Bitterhead; Chub; Gudgeon; Young Shad; Windfish; Goldfish.

RANGE: Nova Scotia, Prince Edward Island, New Brunswick, Quebec, the St. Lawrence River and the eastern part of the Lake Ontario basin, southward on the eastern slope of the Appalachians to Virginia.

OCCURRENCE IN NOVA SCOTIA: The most widely distributed and also the most common minnow in Nova Scotia. Common throughout, even in granite areas, except for extremely isolated regions such as the Cape Breton plateau and Digby Neck.

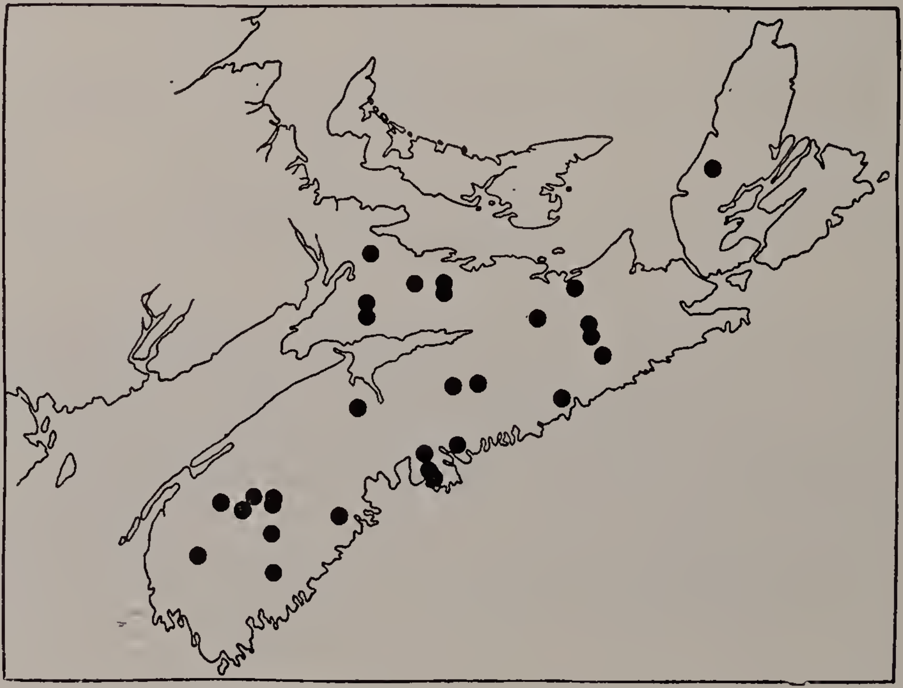


Figure 17. Distribution of Eastern Golden Shiner—*Notemigonus c. crysoleucas* in Nova Scotia.

Specimens in the Nova Scotia Museum of Science collections from:

Copper Lake, Antigonish, Co N. S.	June 28, 1946
Lake George, Shelburne Co., N. S.	July 6, 1946
Red Lake, Annapolis Co., N. S.	June 29, 1949
Little River, Annapolis Co., N. S.	July 5, 1949
Mill Lake, Annapolis Co., N. S.	June 20, 1949
Medway River, near Caledona, Queens Co., N. S.	June 30, 1949

Fullerton Lake, Cumberland Co., N. S.	September 25, 1948
Gilbert Lake, Cumberland Co., N. S.	September 27, 1948
Goshen Lake, Guysborough Co., N. S.	August 3, 1948
White's Lake, Halifax Co., N. S.	June 26, 1948
Hubley Big Lake, Halifax Co., N. S.	June 24, 1948
Copper Lake, Antigonish Co., N. S.	August 2, 1948
Pearl Lake, Yarmouth Co., N. S.	September 16, 1948
Sherbrook Brook, Guysborough Co., N. S.	August 2, 1948
Lake Ainslie, Inverness Co., N. S.	September 9, 1948
Big Dam Lake, Annapolis Co., N. S.	July 5, 1949
Pretty Mary Lake, Annapolis Co., N. S.	June 30, 1949
Mink Lake Brook, Annapolis Co., N. S.	July 6, 1949
Little Lake, Grand Lake, Hants Co., N. S.	September 1, 1949
Minamkeak Brook, Lunenburg Co., N. S.	June 4, 1950
River at Antigonish, Antigonish Co., N. S.	1908
Maynard's Lake, Halifax Co., N. S.	1910
Shubenacadie River, Elmsdale, Halifax-Hants Co.	1920
Blueberry Lake, Bay Road, Halifax Co.	1897
Small Lake on Windsor Road near St. Croix, Hants Co., N. S.	July 13, 1950
East River Sheet Harbour, Halifax Co., N. S.	July 18, 1950
Small lake near Lorne, Pictou C., N. S.	July 19, 1950
Ponds near Cornwallis River, Kings Co., N. S.	May 31, 1950

DESCRIPTION: The Eastern Golden Shiner is said to tolerate salt water for a short time (Hubbs, Carl L., (personal communication) and this may explain in part its wide dispersal through Nova Scotia.

This Shiner feeds more on animal plankton, chiefly water flies, than on any other main group of organisms, but also upon insects, molluscs, water mites, protozoans, algae, remains of higher plants and small fishes. No detailed description of its spawning act is available, but the eggs are said to be scattered over beds of rooted aquatic plants or masses of filamentous algae.

Cooper (1935) has studied the age and growth of the western subspecies quite extensively. He found the following relation between age and size:

Summer	Length in inches
2	3.0
3	4.0

Summer	Length in inches
4	4.5
5	5.0
6	5.5

The oldest fish found was 8 years of age.

REFERENCES: Cooper, Gerald P. 1935.

Northern Blacknose Shiner—*Notropis heterolepis heterolepis.* Eigenmann

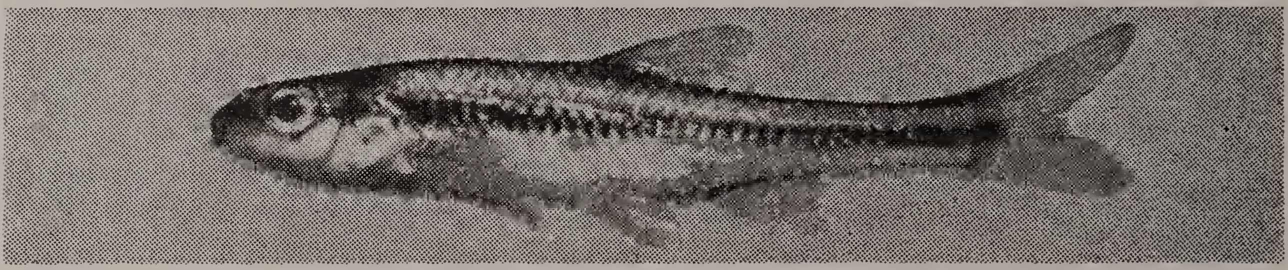


Figure 18. Northern Blacknose Shiner—*Notropis h. heterolepis.* Life Size.

OTHER COMMON NAMES: Black-nosed Minnow.

RANGE: Nova Scotia to Saskatchewan, south to Pennsylvania and North Dakota.

OCCURRENCE IN NOVA SCOTIA: Common in the soft-rock areas from Windsor, Hants county, to Goshen Lake, Guysborough County.

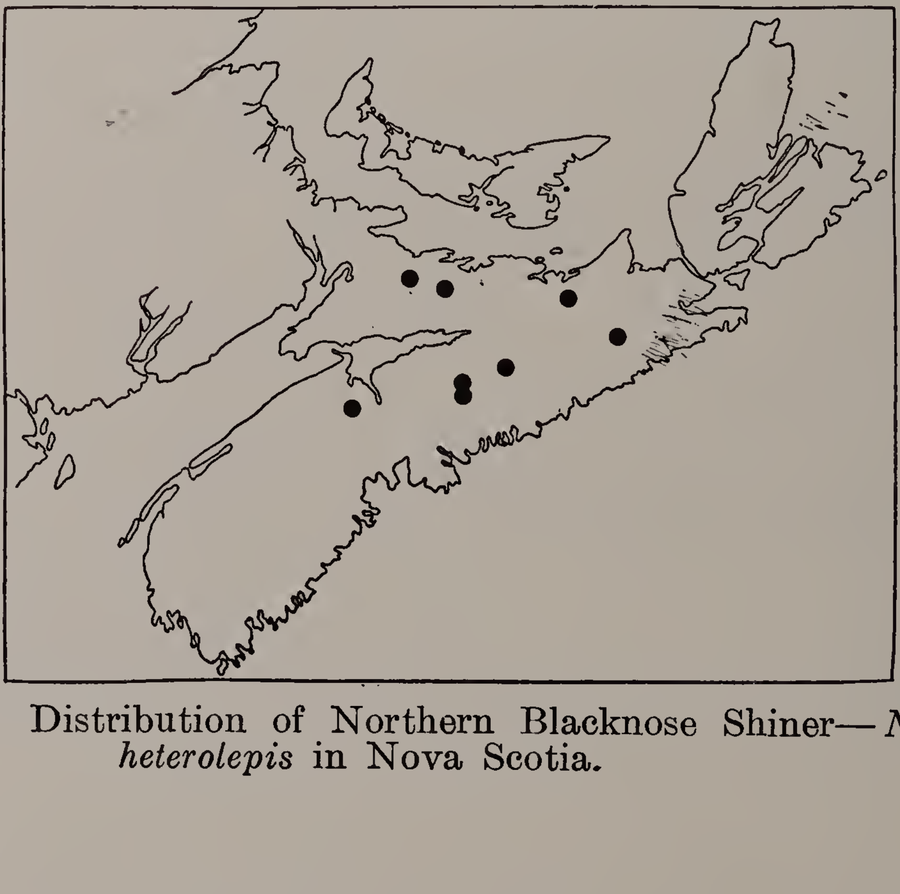


Figure 19. Distribution of Northern Blacknose Shiner—*Notropis h. heterolepis* in Nova Scotia.

Specimens in Nova Scotia Museum of Science collections from:—

Little Lake, Grand Lake, Hants Co., N. S.	September 1, 1949
Goshen Lake, Guysborough Co., N. S.	August 3, 1949
Small Lake on Windsor Road, near St. Croix, Hants Co.	July 13, 1950
Small lake near Lorne, Pictou Co., N. S.	July 19, 1950

DESCRIPTION: This little minnow is one of our lesser-known species. So far as can be discovered, there is no detailed description of its spawning behavior available, and very little information exists concerning its food and growth. It is believed however, to feed principally on microscopic plants, although small crustaceans, insects and other invertebrates are also eaten. Maturity is attained at lengths of 2 to 3 inches. Because it never attains a large enough size to compete with game fishes, the Northern Blacknose Shiner is probably a very valuable forage fish.

REFERENCES: Adams and Hankinson 1928.

Common Shiner—*Notropis cornutus.* Mitchill

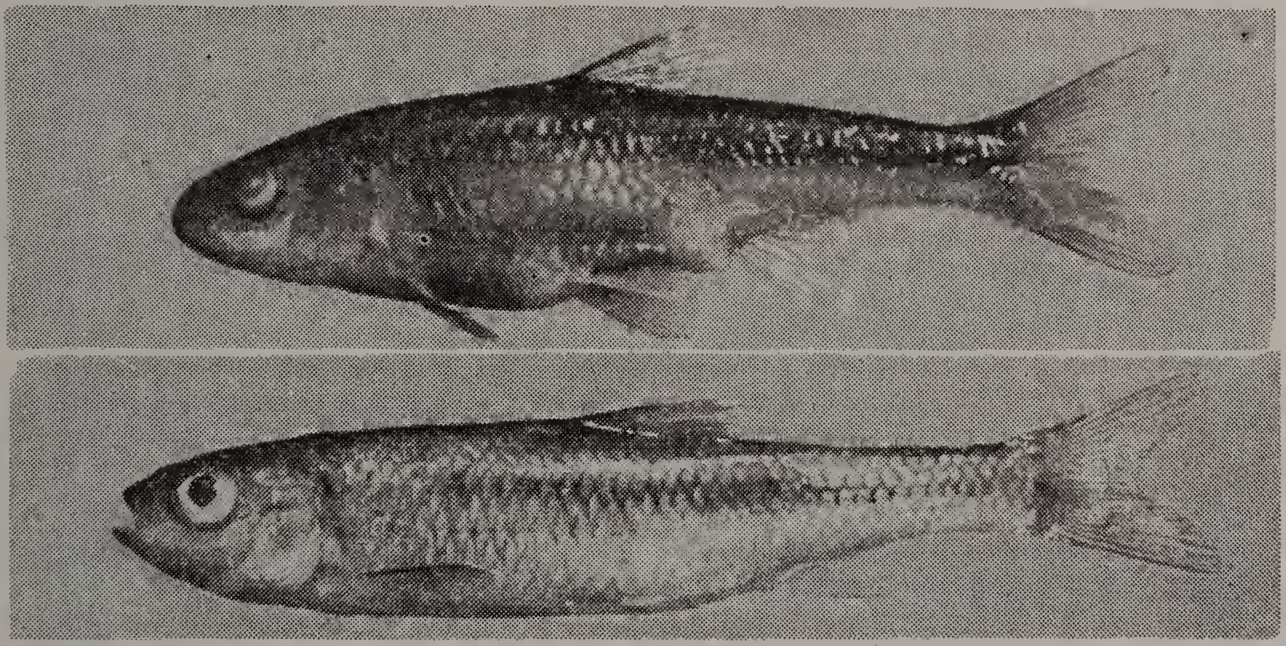


Figure 20. Common Shiner—*Notropus cornutus.*

Other common names: Eastern Shiner; Redfin Shiner; Silver Shiner; Dace; Silverside; Rough-head; Hornyhead.

Range: Nova Scotia to Saskatchewan, south to Missouri, Arkansas, Oklahoma and Alabama.

Occurrence in Nova Scotia: From Goshen Lake, Guysborough Co. to Pockwock Lake, Halifax County, and northwestward to Gilbert Lake, Cumberland County.

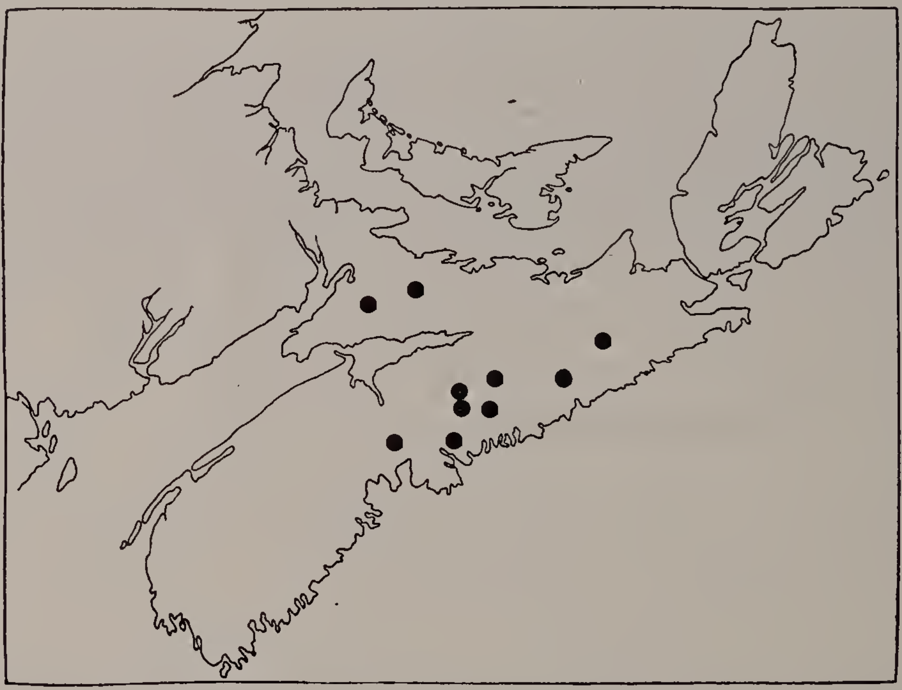


Figure 21. Distribution of Common Shiner—*Notropis cornutus* in Nova Scotia.

Specimens in Nova Scotia Museum of Science collections from:

Gilbert Lake, Cumberland Co., N. S.	September 24, 1948
Goshen Lake, Guysborough Co., N. S.	August 3, 1948
Grant Brook, Hants Co., N. S.	June 12, 1949
Tributary of the Musquodoboit River, Halifax Co., N. S.	June 12, 1949
Little Lake, Grand Lake, Colchester Co., N. S.	September 1, 1949
Wright's Lake, south of Pockwock P.O., Halifax Co.	1918
Shubenacadie River, Elmsdale, Halifax-Hants Co.	1919

Description: The Common Shiner is an omnivorous feeder, eating small fishes, insects, crustacea, algae, and even the remains of rooted plants. Like most of the Cyprinidae, or true minnows, the Common Shiner exhibits a rather complex and interesting spawning behaviour, which has been very thoroughly investigated by a number of workers. Raney summarizes it as follows:

"1. In May an inshore migration in lakes, and, in some cases at least, an upstream movement is made by *Notropis cornutus.*

"2. Sexual dimorphism is pronounced. Breeding males have well developed pearl organs or breeding tubercles, are highly colored and reach a larger size than breeding females. The breeding tubercles on the various parts of the body are of value in the fighting which occurs among the males, in driving away predators and in the breeding act.

"3. Spawning occurs from the first of May through the middle of July in the northeastern states, beginning usually when the water has reached a temperature of 60 to 65 F. At any one locality, spawning lasts about ten days and is limited to the daylight hours.

"4. The common shiner may (1) spawn over gravel beds in running water, (2) excavate small depressions in gravel or sand in running water or (3) utilize the nests built by any other species such as *Nocomis micropogon*, *Nocomis biguttatus*, *Leucosomus corporalis*, *Semotilus atromaculatus atromaculatus*, *Exoglossum maxillingua* and *Compostoma anomalum*, whether these are built in running water or the still waters of shallow pools. They prefer to spawn over the nests of other species when these are available.

"5. Hybridization often occurs with *Notropis cornutus* as one parent largely as a result of their spawning over the nests of other fishes.

"6. The number of males that will spawn over one nest varies considerably, there being from one hundred or more over a gravel bed to as few as one male over a small depression. More females are present at the nests than males.

"7. Males fight continuously for the leading position, the position furthest upstream in the nest.

"8. A male shiner recognizes a female and takes a semi recumbent position alternately from one side to the other, when the female approaches from the downstream side of the nest, head facing upstream and moving slightly from side to side.

"9. The female takes the initiative in the breeding act by dipping downward to lie beside the male. The male throws his caudal peduncle over that of the female, curves his body by bringing his head and tail in close proximity with his pectoral fin underneath the head of the female. The eggs are forced from the female at this moment while she lies, usually on her side, her ventral surface facing upstream and her head pointing toward shore. The entire breeding act is over in a fraction of a second and the details cannot be seen clearly with the unaided eye.

"10. Probably fewer than fifty eggs are laid at once. The demersal eggs become adhesive after water-hardening in about two minutes after being laid and drop between the pebbles on the bottom of the nest to which they adhere. When first laid, they are orange and average 65 mm. in diameter."

Because it spawns in clear streams, the breeding behavior of *Notropis cornutus* can easily be observed by any interested person with patience enough to remain still for half an hour or so.

The males reach a length of up to 8 inches; the females are somewhat smaller. (Our subspecies appears to be the typical one.)

REFERENCES: Raney, E. C. 1940.
Hubbs, Carl L. and Cooper, Gerald P. 1936.

THE NORTH AMERICAN CATFISH FAMILY—*Ameiuridae*

Only one species is found in Nova Scotia.

Northern Brown Bullhead—*Ameiurus nebulosus nebulosus.* Le Sueur

OTHER COMMON NAMES: Common Catfish; Small, Marbled, Square-tail, Bullhead or Black Catfish; Schuylkill Cat; Sacramento Cat; Common Bullhead; Horned Pout; Hornpout; Minister; Barbotte.

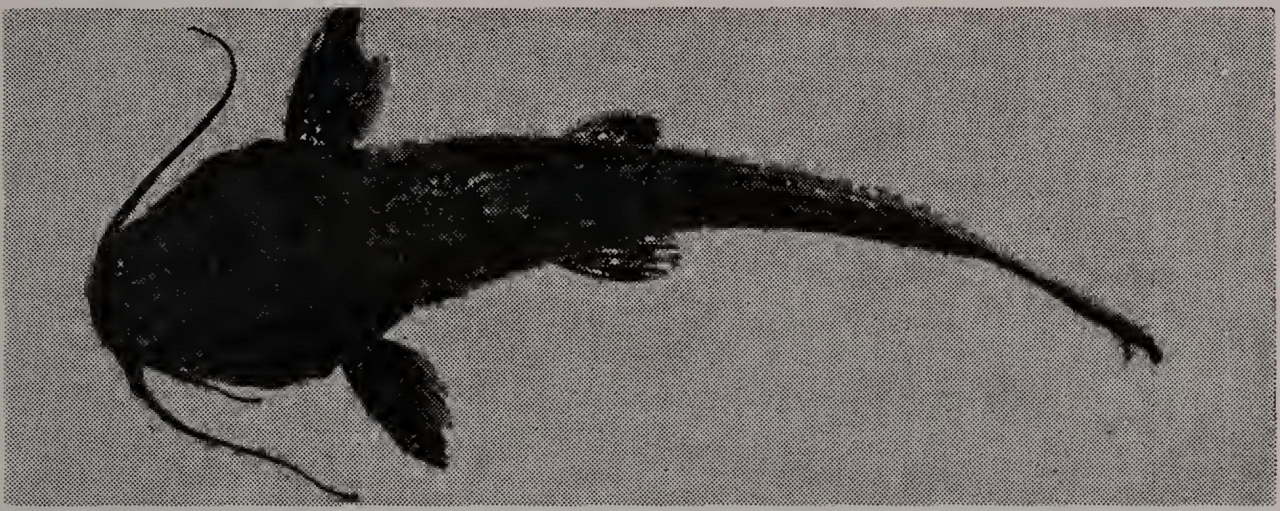


Figure 22. Northern Brown Bullhead—*Ameiurus n. nebulosus* Top view 6/5 Life Size

Range: From Nova Scotia to Manitoba and south to Virginia and the northern part of the Ohio Valley.

Occurrence in Nova Scotia: Locally abundant in lakes and occasionally in streams from Hants and Halifax counties except in the granite areas. Probably occurs throughout the rest of the Nova Scotia mainland.

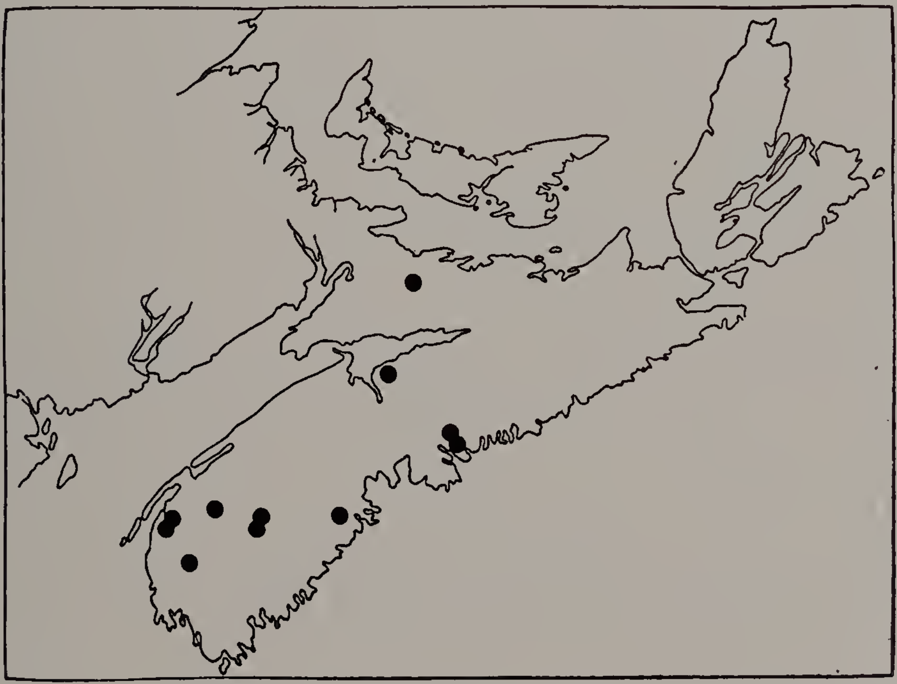


Figure 23. Distribution of Northern Brown Bullhead—*Ameiurus n. nebulosus* in Nova Scotia.

Specimens in Nova Scotia Museum of Science collections from:

Dartmouth Lake, Halifax Co., N. S.	1885
First Dartmouth Lake, Halifax Co., N. S.	1910
Red Bridge Pond, east side of 2nd Dartmouth Lake, Halifax Co., N. S.	1910
Lily Lake, Hants Co., N. S.	July 12, 1947
Meteghan River, Digby Co., N. S.	July 30, 1949
Spectacle Brook, Digby Co., N. S.	July 30, 1949
Kejimkujik Lake, Queens Co., N. S.	June 29, 1949
Pearl Lake, Yarmouth Co., N. S.	September 16, 1948
Big Dam Lake, Annapolis Co., N. S.	June 29, 1949
Minamkeak Lake, Lunenburg Co., N. S.	July 4, 1950

DESCRIPTION: The Bullhead is a very hardy fish, tolerating higher temperatures and lower oxygen tensions than most Nova Scotia fishes. It is characteristic of quiet waters, where it feeds on small fish, molluscs, crustaceans, insects—in short any available animals which it can catch and devour. The Bullhead spawns in spring in sandy bays up to 2 feet deep, where the parents excavate a nest by removing a bushel or so of the bottom material in their mouths. Both parents, but particularly the male, are very zealous in their care of the developing eggs, fanning them with their lower fins and also agitating the eggs by taking them into their mouths and blowing them out. The adults continue to watch over the fry for some time after hatching, but aquarium observations indicate that finally this parental behaviour is overcome by their predacious feeding habits, and they will eat the young if possible.

The Bullhead reaches a length of 18 inches and a weight of 6 pounds, but this is unusual. Very few exceed a pound or two in weight.

REFERENCES: Adams and Hankinson 1928.
Breder, C. M. Jr., 1935, 1939

THE PIKE FAMILY—*Esocidae*

Only one species in Nova Scotia.

Chain Pickerel—*Esox niger.* Le Sueur

OTHER COMMON NAMES: Pickerel; Eastern, Federation, Lake, Pond, Reticulated or Grass Pickerel; Green Pike; Black Chain, Duck-billed or Lake Pike; Jack; Picquerelle.

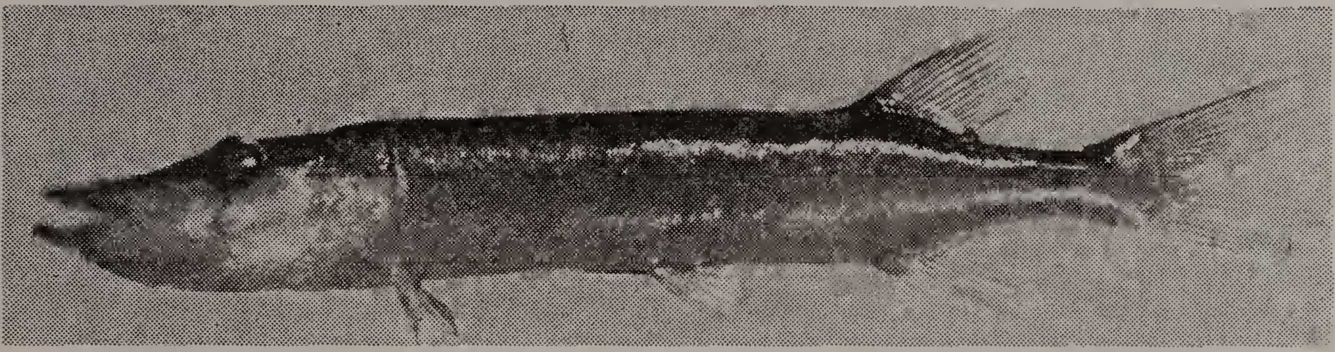


Figure 24. Chain Pickerel—*Esox niger.* Juvenile.
5/6 Life Size

RANGE: New Brunswick to Lake Ontario, south to Florida, Texas, Missouri and Alabama; introduced into the Lake Erie drainage of New York.

OCCURRENCE IN NOVA SCOTIA: Occurs only in several lakes on or near the Spectacle Brook drainage near Comeauville, Digby County, N. S. According to local tradition it was introduced from the United States about a generation ago by a man named Comeau. It is very common within its limited range.

Specimens in Nova Scotia Museum of Science collections from:

Lac a Jeune, Digby Co., N. S.	September 16, 1948
Upper Spectacle Lake, Digby Co., N. S.	July 26, 1949
Lower Spectacle Lake, Digby Co., N. S.	July 26, 1949
Henriette Lake, Digby Co., N. S.	July 27, 1949
Upper Spectacle Lake, Digby Co., N. S.	July 30, 1949
Spectacle Brook, Digby Co., N. S.	July 30, 1949
Lower Spectacle Lake, Digby Co., N. S.	July 28, 1949

DESCRIPTION: Raney has studied the summer food of *Esox niger* in a small New York pond. He summarizes his results thus: "The main difference, as one might expect, between the food of young and older pickerel is largely in the sizes of the food organisms . . . With the very small pickerel, micro-crustaceans were important. After the middle of June insects were the dominant food, but young golden shiners were taken in numbers and made up about 14% of the stomach contents . . . . Among the insect food, mayfly nymphs predominated, though those of dragonflies were also eaten. Gradually more fishes, such as golden shiners common shiners and common sunfishes, were eaten and in general fewer insects were taken.

"With older pickerel, fishes and crayfishes were about equally important . . . . Insects were of minor value and those found in the stomachs were mostly large dragonfly nymphs. Young bullheads, sunfishes and pickerel were eaten by the larger pickerel but all of the golden shiners taken were more than one year old. No crayfishes were found in the stomachs of young pickerel, but they were very important food for those over 150 mm. in standard length at all times during the summer. An increasing tendency for the specimens larger than 300 mm. standard length to eat crayfishes was noted . . . . ."

Chain pickerel reach a weight of 5 pounds and a length of about 2 feet.

Esox niger spawns in the spring, about two weeks after the ice goes out. The eggs are laid in shallows or flooded meadows, the two parents swimming along gently with sides touching, occasionally lashing the water with their tails as roe and milt are expelled.

The Digby county Pickerel are thriving mightily and may be expected to extend their range. They are not at all popular with the local inhabitants, who regard them as severely inimical to the best interests of trout and perch.

REFERENCES: Adams and Hankinson 1928.
Raney, Edward C. 1942
Hunter, George W. III, and Rankin, John S. Jr. 1939

THE FRESHWATER EEL FAMILY—*Anguillidae*

Only one species in Nova Scotia.

American Eel—*Anguilla rostrata,* Le Sueur

Other common names: Common Eel; Freshwater or Silver Eel; Easgann.

Range: Eastern North America, and (rarely) southern North American, from southern Greenland and Labrador to Brazil.

Occurrence in Nova Scotia: Probably common throughout, with the possible exception of the plateau of northern Cape Breton. Most of the gear used in the present study would not catch Eels, so the small number of collection localities should not be considered an indication of scarcity.

Specimens from the Nova Scotia Museum of Science collections are:

Nictaux River, near Middleton, Annapolis Co.	June,	1910
Copper Lake, Antigonish Co., N. S.	June	27, 1946
Spectacle Brook, Digby Co., N. S.	July	30, 1949
Lower Spectacle Lake, Digby Co., N. S.	July	30, 1949
Small Lake on Windsor Road near St. Croix, Hants Co., N. S.	July	13, 1950

Description: The Eel spawns only in deep waters of the ocean, between Bermuda and the West Indies. The time of spawning lasts from late winter and early spring until summer. After hatching, the young leaf-shaped larvae spend about a year in migrating from the spawning area to the American coast, where they change into the small Eels known as Elvers. The Elvers enter fresh water during the spring of the year, and live there until they mature, at an age of about 6½ to 8½ years. (A case is recorded, however, of an Eel living in captivity for 37 years.)

At maturity the Eel undergoes a remarkable change. It gradually ceases to feed; the underpart of the body becomes clearer and whiter, the dorsal region turns darker, and the eyes enlarge. The Silver Eel, as it is now commonly called, heads for the ocean breeding ground, where it spawns and dies.

It is an interesting fact that male Eels very seldom attain a length of over 16 inches, and as a rule do not ascend the rivers above tidewater, so that the large Eels found in the lakes and streams at the river headwaters are all females. These females may attain a size of as much as 6 feet, but the majority are less than half this length.

Its body shape brings down upon the Eel much of the prejudice and superstition traditionally associated with snakes. Thus, although its flesh is very tasty, whether fresh or smoked, and forms the basis of a $13,000. fishery in this province alone, many people will not eat it. Similarly, although almost nothing is known concerning the relation of the Eel to other fishes, a general belief exists that it is the principal enemy of all game fishes.

REFERENCES: Adams, Charles C. and Hankinson, F. L. 1928.
Bishop, S. C. 1935
Frost, W. E. 1945.
Hartley, P. H. T. 1940.

THE KILLIFISH FAMILY—*Cyprinidontidae*

Only one species in the fresh water of Nova Scotia.

Eastern Banded Killifish—*Fundulus diaphanus diaphanus.* Le Sueur.

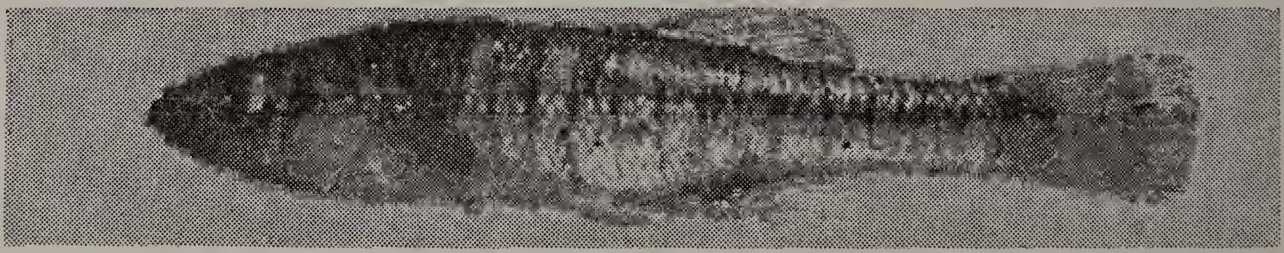


Figure 25. Eastern Banded Killifish, *Fundulus d. disphanus* Life side.

RANGE: From the Maritime Provinces south to South Carolina; west through the eastern parts of Pennsylvania, Ontario and New York including the Lake Champlain basin.

OCCURRENCE IN NOVA SCOTIA: One of the most widely distributed fishes in the province. Very common in the shallow waters of lakes and streams throughout the province, except on the plateau of northern Cape Breton.

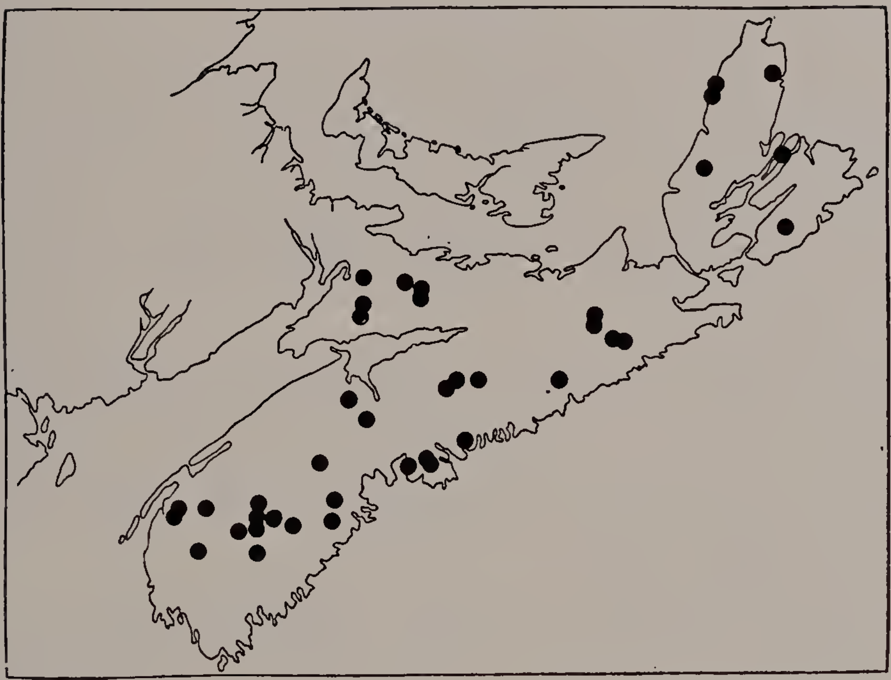


Figure 26. Distribution of Eastern Banded Killifish, *Fundulus d. diaphanus* in Nova Scotia.

Specimens in the Nova Scotia Museum of Science collections from:

Sherbrooke Lake, Lunenburg Co., N. S.	1946
Lake Henry, Halifax Co., N. S.	June 11, 1946
Elliott Lake, Annapolis Co., N. S.	July 11, 1946
Doyle Lake, Halifax Co., N. S.	August 22, 1947
Red Lake, Annapolis Co., N. S.	July 1, 1949
Kejimkujik Lake, Queens Co., N. S.	June 19, 1949
Lower Spectacle Lake, Digby Co., N. S.	July 26, 1949
Meteghan River, Digby Co.	July 27, 1949
Mulgrave Lake, Annapolis Co., N. S.	July 6, 1949
Mill Lake, Annapolis Co., N. S.	June 30, 1949
Medway River, near Caledonia, Queens Co., N. S.	June 30, 1949
Freeman Lake, Queens Co., N. S.	June 30, 1949
Copper Lake, Antigonish Co., N. S.	August 1948
2nd Indian Harbour Lake, Guysborough Co., N. S.	August 1, 1948
Lake Ainslie, Invesness Co., N. S.	September 9, 1948
Indian Harbour River, Guysborough Co., N. S.	August 1, 1948
Goshen Lake, Guysborough Co., N. S.	August 3, 1948
Pearl Lake, Yarmouth Co., N. S.	September 16, 1948
La Have River, Lunenburg Co., N. S.	June 20, 1948
Fullerton Lake, Cumberland Co., N. S.	September 25, 1948
Loch Lomond, Cape Breton Co., N. S.	September 26, 1948
Gilbert Lake, Cumberland Co., N. S.	September 24, 1948
Big Dam Lake, Annapolis Co., N. S.	July 5, 1949

Liverpool River, Annapolis Co., N. S.	July 6, 1949
Pollock Lake, Queens Co., N. S.	July 2, 1949
Pretty Mary Lake, Annapolis Co., N. S.	June 30, 1949
Mink Lake Brook, Antigonish Co., N. S.	July 6, 1949
Le Grand Lac, Grand Etang, Inverness Co., N. S.	August 22, 1949
Le 'ti Lac, Grand Etang, Inverness Co., N. S.	August 22, 1949
Warren Lake, Victoria Co., N. S.	August 26, 1949
Dalem Lake, Victoria Co., N. S.	August 29, 1949
Little Lake, Grand Lake, Hants Co., N. S.	September 1, 1949
Leipsigate Lake, Lunenburg Co., N. S.	June 5, 1950
Minamkeak Brook, Lunenburg Co., N. S.	June 4, 1950
Shubenacadie River, Near Milford, Hants Co., N. S.	1919
Dauphinee Beach, Hubbards, Halifax Co., N. S.	1915
Little Salmon River, Cole Harbour, Halifax Co., N. S.	1910
Small Lake on Windsor Road, near St. Croix, Hants Co., N. S.	July 13, 1950
Cameron Lake, Hants Co., N. S.	July 19, 1950
East River, Sheet Harbour, Halifax Co., N. S.	July 18, 1950
Ponds near Cornwallis River, Kings Co., N. S.	May 31, 1950

Another species of *Fundulus*, *F. heteroclitus* inhabits the salt and brackish waters of the province. It can be distinguished from *F. diaphanous* by its much shorter snout, stouter body and rounded tail.

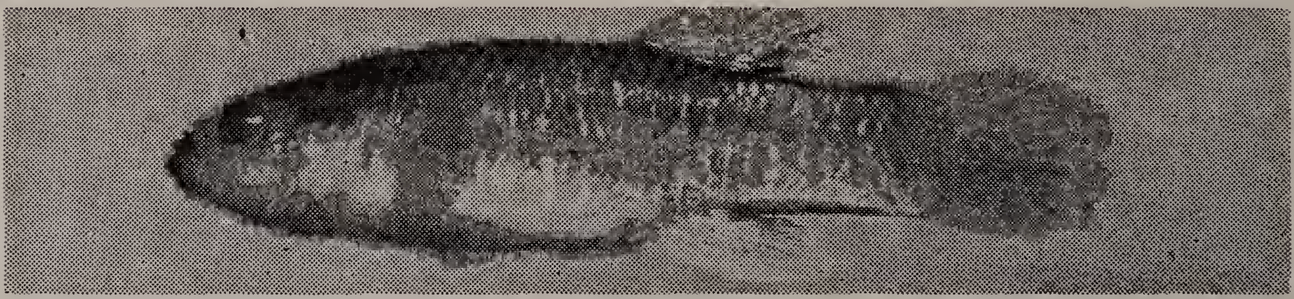


Figure 27. Mummichog—*Fundulus heteroclitus* (Life size)

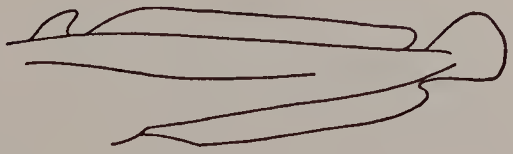
Description: *Fundulus diaphanus* along with its marine relative, is the "minnow" of Nova Scotia anglers. It is so much hardier than the true minnows or Cyprinidae, that they are not used for bait at all.

The anglers keep Fundulus alive by packing it in dry leaves in an old tin can. It will live in this way, completely without water, for several days, and successful air shipments of the salt water species from Halifax to Central Canada have been made by commercial bait dealers.

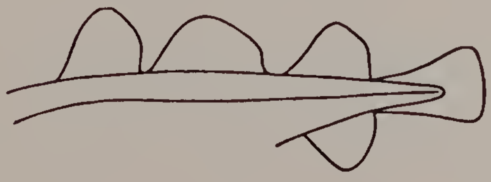
Both species of Fundulus grow to about 4 inches.

THE COD FAMILY—*Gadidae*

1. Two dorsal fins, one short, one very long—American Burbot. *Lota lota maculosa,* LeSueur—Page 59.



2. Three subequal dorsal fins —Tomcod. *Microgadus tomcod,* Walbaum. Page 60.



American Burbot—*Lota lota maculosa.* Le Sueur

Other common names: Lake Lawyer; Ling; Skin Ling; Alekey Trout; Eelpout; Longtailed Cat; Mud Blower; Freshwater Cusk; Gudgeon; Lush.

Range: New Brunswick to the Yukon; south to the Connecticut, Dealware and Susquehanna systems and all the Great Lakes basins; in the Missouri River system south to Missouri, Kansas and Wyoming; in the Mississippi River and tributaries throughout Minnesota; also in the Columbia River watershed.

Occurrence in Nova Scotia: Not known to occur in Nova Scotia; but since it is found in New Brunswick, it may possibly be found here at some later date.

There are no specimens in the Nova Scotia Museum of Science collection.

Description: Until the discovery recently by M. Vianney Legendre of a landlocked population of Tomcod in Lake St. John, Quebec, the Burbot was believed to be the only fresh-water member of the cod family. It is a deep-water fish, coming into shallower water at night to feed, and is generally found over muddy bottoms, except during early spring, when it spawns on hard or rocky bottoms. The Burbot is a voracious fish, feeding largely upon small fishes, but also upon crustaceans and insects. A size of 2 or 3 feet is common.

REFERENCES: Adams and Hankinson 1928.

Tomcod—*Microgadus tomcod.* Walbaum

OTHER COMMON NAMES: Frostfish, Tommycod.

RANGE: Atlantic coast of America, from Labrador to Virginia.

OCCURRENCE IN NOVA SCOTIA: Vladykov and McKenzie state that this fish is very common in the coastal waters of the whole region. It is probably anadromous in practically all of the province's streams, although, since it ascends into fresh water only in winter, it is seldom caught away from the sea.

There are three specimens in the Nova Scotia Museum of Science collections, but they bear no locality label beyond "Nova Scotia."

DESCRIPTION: In Nova Scotia the Tomcod is a salt-water fish running up the estuaries in the winter to spawn. A landlocked population has been discovered in Lake St. John, Quebec, and it is perhaps within the limits of possibility that similar populations exist in some of the larger Nova Scotia lakes, such as Grand Lake. Sea-run individuals grow to about 14 inches.

About 28,000 lbs. of Tomcod are caught annually in the estuaries, with a value of some $400.00

REFERENCES: Valdykov, V. D. and McKenzie, R. A. 1935.

THE BASS FAMILY—*Serranidae*

Dorsal fins separate; 3 spinous, 12 soft anal rays; lower jaw projecting. Striped Bass, *Roccus saxatilis*, Walbaum.

Dorsal fins joined; 3 spinous, 9 soft anal rays; jaws subequal. White Perch, *Morone americana*, Gmelin. Page 61.

White Perch—*Morone americana.* Gmelin

Other common names: Silver Perch, Sea Perch; Bass; Gatte; Narrow-mouthed Bass;

Range: Atlantic Coast of America, from the Maritime Provinces to South Carolina.

Occurrence in Nova Scotia: In lakes throughout the province, except in the granite areas and on the plateau of northern Cape Breton. The White Perch is also found in the sea.

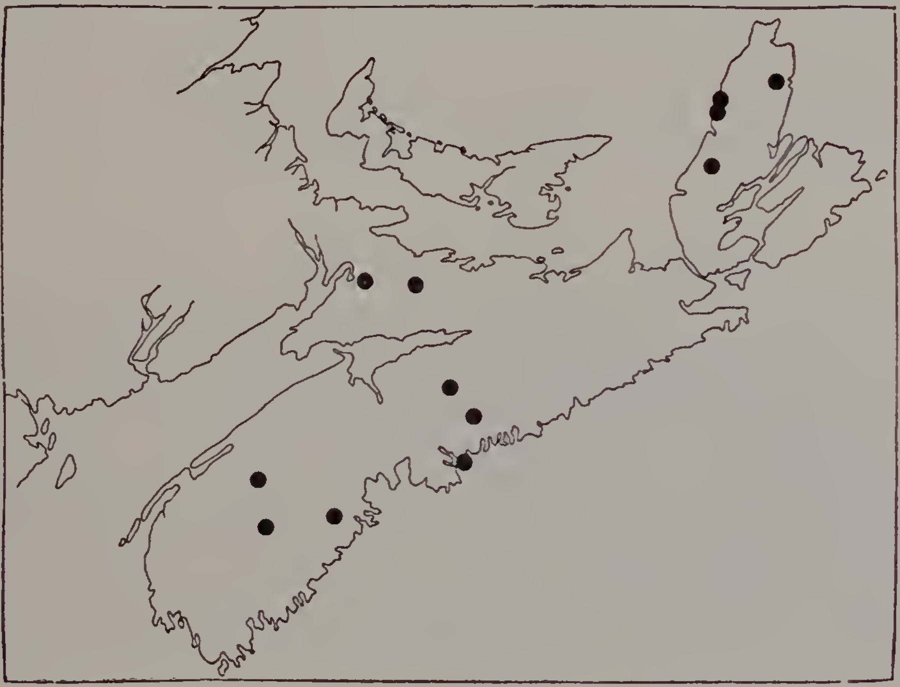


Figure 28. Distribution of White Perch—*Morone americana* in Nova Scotia.

Specimens in the Nova Scotia Museum of Science from:

Lake Ainslie, Inverness Co., N. S.	September 8, 1948
Grand Lake, Halifax Co., N. S.	June 4, 1948
Big Dam Lake, Annapolis Co., N. S.	July 5, 1949
Pollock Lake, Queens Co., N. S.	July 2, 1949
Le Grand Lac, Grand Etang, Inverness Co., N. S.	August 22, 1949
Le 'ti 'Lac, Grand Etang, Inverness Co., N. S.	August 22, 1949
Warren Lake, Victoria Co., N. S.	August 26, 1949
Minamkeak Lake, Lunenburg Co., N. S.	June 3, 1950
Cow Bay Pond, Halifax Co., N. S.	August 5, 1910
Near Cow Bay, Halifax, Co., N. S.	1901
Creeks off Musquodoboit, Halifax Co., N. S.	June 23, 1924

Description: The White Perch reaches a maximum length of 15 inches, with a weight of about 3 pounds, but most specimens taken by anglers are much smaller than this. Observations by field workers of the Nova Scotia Inland Fisheries Survey on the La Have River indicate the existence of a seaward migration during the summer.

THE PERCH FAMILY—*Percidae*

Bones of head serrate; mouth large, upper jaw extending to middle of eye or beyond; branchiostegals 7; reaching a moderately large size. Yellow Perch, *Perca flavescens*, Mitchill, Page 62.

Bones of head smooth; mouth small, upper jaw not reaching middle of eye; branchiostegals 6, maximum length only about 2½ inches. Johnny Darter, *Boleosoma nigrum*, Rafinesque, Page 64.

Yellow Perch—*Perca flavescens.* Mitchill

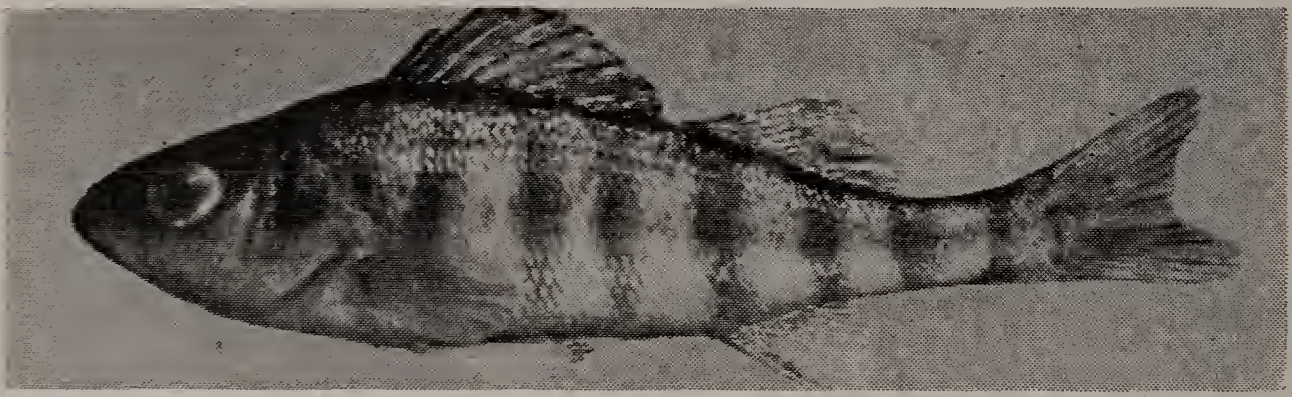


Figure 29. Yellow Perch—*Perca flavescens* Juvenile. Life size.

Other common names: Perch; American Perch; Ringed or Racoon Perch.

Range: Nova Scotia to Great Slave Lake, south to Missouri, Illinois, Indiana, Ohio, Pennsylvania and South Carolina.

Occurrence in Nova Scotia: Very common in lakes and streams throughout the soft rock areas on the mainland of Nova Scotia, known from only one locality (Mulgrave Lake, Annapolis County, N. S.) in the granite area; has not been recorded from Cape Breton Island as yet.

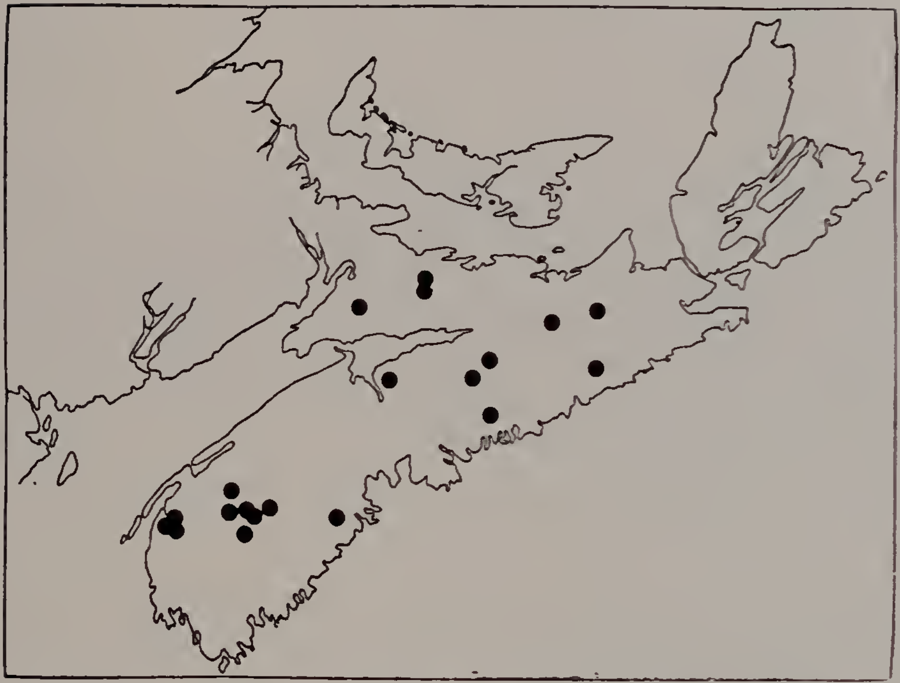


Figure 30. Distribution of Yellow Perch—*Perca flavesceus* in Nova Scotia.

Specimens in Nova Scotia Museum of Science collections from:—

References

Copper Lake, Antigonish Co., N. S.	June 27, 1946
Lily Lake, Hants Co., N. S.	July 15, 1947
Red Lake, Annapolis Co., N. S.	July 1, 1949
Kejimkujik Lake, Queens Co., N. S.	June 29, 1949
Red Lake, Annapolis Co., N. S.	June 29, 1949
Minard Lake, Queens Co., N. S.	June 30, 1949
Little River, Annapolis Co., N. S.	July 5, 1949
Lower Spectacle Lake, Digby Co., N. S.	July 26, 1949
Meteghan River, Digby Co., N. S.	July 27, 1949
Upper Spectacle Lake, Digby Co., N. S.	July 29, 1949
Kejimkujik Lake, Queens Co., N. S.	June 29, 1949
Mulgrave Lake, Annapolis Co., N. S.	July 6, 1949
Mill Lake, Annapolis Co., N. S.	June 30, 1949
Medway River, near Caledonia, Queens Co.	June 30, 1949
Freeman Lake, Queens Co., N. S.	June 30, 1949
Copper Lake, Antigonish Co., N. S.	August 1948
Gilbert Lake, Cumberland Co., N. S.	September 24, 1948
Sherbrook Brook, Guysborough Co., N. S.	August 2, 1948
Big Dam Lake, Annapolis Co., N. S.	July 5, 1949
Pollock Lake, Queens Co., N. S.	July 2, 1949
Pretty Mary Lake, Annapolis Co., N. S.	June 30, 1949

Mink Lake Brook, Annapolis Co., N. S.	July 6, 1949
Little Lake, Grand Lake, Colchester Co., N. S.	September 1, 1949
Minamkeak Brook, Lunenburg Co., N. S.	June 3, 1950
Creeks off Musquodoboit River, Halifax Co., N. S.	June 23, 1924
Shubenacadie River, Milford, Hants Co.	August 1919
Grand Lake, Halifax Co., N. S.	June 10, 1911
East River, Sheet Harbour, Halifax Co., N. S.	July 18, 1950
Small lake near Lorne, Pictou Co., N. S.	July 19, 1950

DESCRIPTION: Although the Yellow Perch is said to attain a weight of 3 or 4 pounds, specimens of over 1 pound are unusually large, at least in Nova Scotia. This is an excellent pan-fish and in places less favored with salmonids than this province, it is regarded as something of a game fish as well.

Tessellated Johnny Darter—*Boleosoma nigrum olmstedi.* Storer

RANGE: From the Maritime Provinces to the Ottawa River, and the eastern part of the Lake Ontario drainage; southward, near the coast, to North Carolina.

OCCURRENCE IN NOVA SCOTIA: Though said to occur in the Maritime Provinces, the Johnny Darter has not been found in Nova Scotia during the course of this investigation.

There are no specimens in the Nova Scotia Museum of Science collections.

THE SUNFISH FAMILY—*Centrarchidae*

Northern Small-mouth Bass—*Micropterus dolomieu dolomieu.* Lacêpède

OTHER COMMON NAMES: Black Bass; Freshwater, Brown, Dwarf, Gold, Green, Hog, Little, Minny, River, Spotted River, Streak-checked River, Swago, Trout, or Yellow Bass; Bass Hogfish; Black Perch; Green Perch; Mountain or White

Trout; Jumper; Speckled Hen; Swego; Achigan Noir; Achigan Petite Bouche.

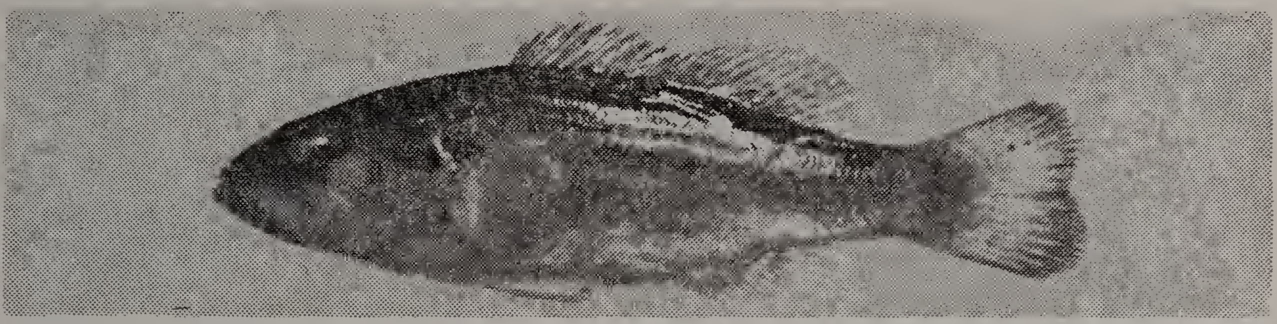


Figure 31. Small-mouth Bass.—*Microterus d. dolmieu.* Juvenile. Life size.

Range: Originally from northern Minnesota to Lake Nipissing and Quebec (with a relict population in the Nipigon River) and south to the Tennessee River drainage of Alabama and to Eastern Oklahoma. Introduced extensively elsewhere.

Occurrence in Nova Scotia: This fish is a native of the central part of North America, but it has been introduced very widely. Plantings have been made in a number of Nova Scotia lakes, including several around Yarmouth and Amherst, and Lily Lake in Hants County.

The only specimens in the Nova Scotia Museum of Science collections are from the Huron River, Michigan U.S.A. September 23rd, 1949.

Description: In the central part of the continent this is a highly prized game fish. It is very vigorous when hooked, and reaches a weight of some 5 pounds. Since it is suspected of destroying trout in marginal trout waters, it should not be stocked indiscriminately in Nova Scotia.

The Bass is a spring and early summer spawner. The male excavates a nest of some 2 or 3 feet in diameter on a gravelly bottom. After spawning, the male watches over the nest and drives off intruders.

References: Adams and Hankinson 1964.

Pumpkinseed—*Lepomis gibbosus.* Linnaeus

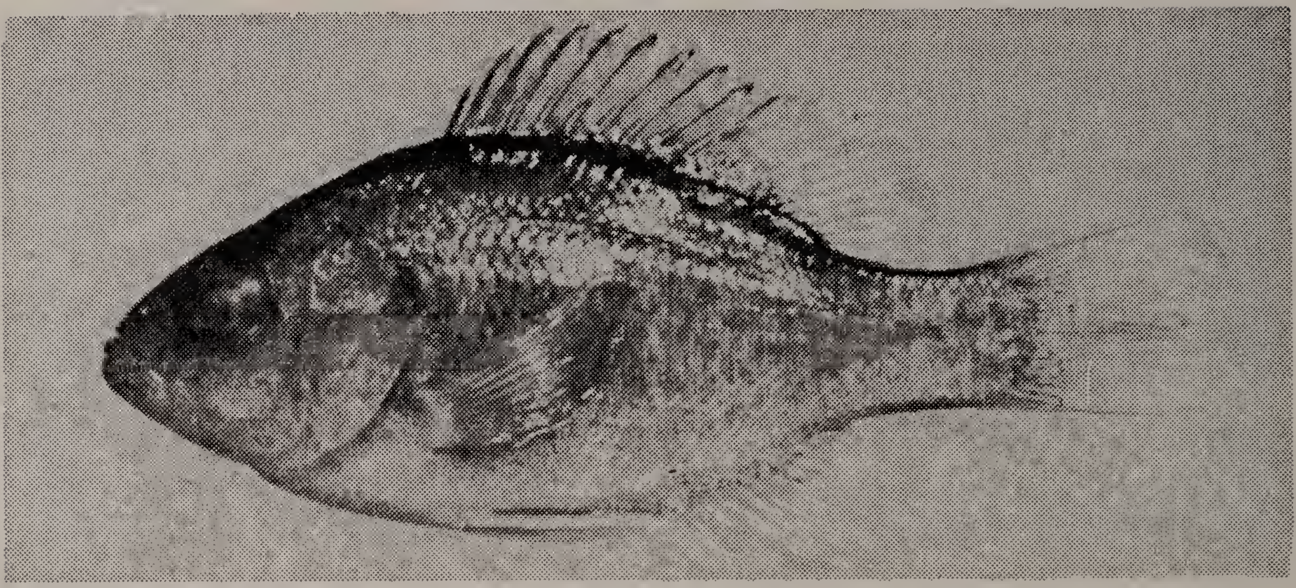


Figure 32. Pumpkinseed—*Lepomis gibbosus*. Juvenile. Life size.

Other common names: Sunfish; Common or Eastern Sunfish; Sun Bass; Sunny, Punky; Perch; Pond, Robin, Sand, Female or Yellow Perch; Harlequin Roach; Roach; Northern Pomotis; Bream; Kiver; Quiver; Redbelly; Robin; Ruff; Tobaccobox; Yellowbelly; Flatfish; Founder; Crapet Jaune.

Range: Southern Canada, and from the Dakotas and the Red River of the north to the Maritime Provinces; south to South Carolina and possibly northern Georgia along the coast, and the western Pennsylvania, Ohio and Iowa in the Mississippi River system.

Occurrence in Nova Scotia: Recorded only once from Nova Scotia, as Common Pond-fish *Pomotis vulgaris*, Cuv. in Knight's *Fishes of Nova Scotia*, 1866. He gave no collection locality, and may have included it in expectation of its future discovery.

The only specimens in the Nova Scotia Museum of Science collections are from the Huron River, Michigan, U. S. A., September 23rd, 1949.

Description: The pumpkinseed reaches a length of about 8 inches.

THE SCULPIN FAMILY—*Cottidae*

Only one species is likely to be found in the fresh water of Nova Scotia.

Common Slimy Muddler—*Cottus cognathus gracilis.* Richardson

OTHER COMMON NAMES: Miller's Thumb; Northern Sculpin; Stargazer.

RANGE: From the Great Lake to Labrador, south to Virginia, west to Minnesota and, in relict colonies, Iowa.

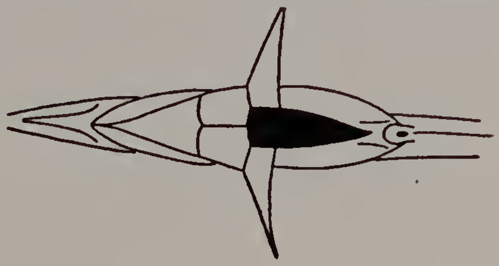
OCCURRENCE IN NOVA SCOTIA: This species is not known to occur in the province, but since it is very common in some New Brunswick streams, such as the Miramichi, it is to be expected in Cumberland County.

There are no specimens in the Nova Scotia Museum of Science.

DESCRIPTION: This is a small fish, seldom larger than 4 inches.

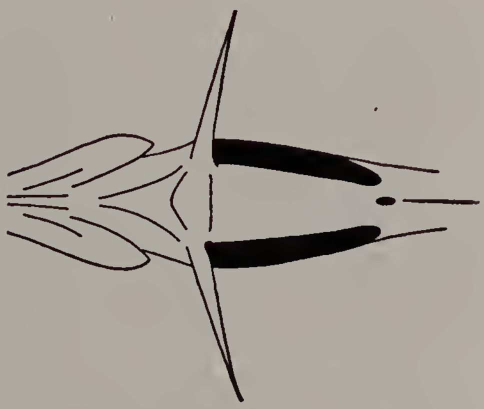
THE STICKLEBACK FAMILY—*Gasterosteidae*

1. Innominate bones of the pelvis joined forming a median plate on belly, behind ventrals—see 6.



Innominate bones not joined, each extending as a strong process under the skin, outside the ventrals, the area between them flat and not bony; dorsal spones usually 4.

Four-spine Stickleback, *Apeltes quadracus.* Mitchill. Page 68.



2 Dorsal spines 5 to 11—see 3.

Dorsal spines 3—Three-spine Stickleback, *Gasterosteus aculeatus,* Linneaus. Page 69.

3. Dorsal spines 7 to 11—Nine-spine Stickleback, *Pungitius pungitius*, Linneaus. Page 70.
   Dorsal spines usually 5.—Brook Stickleback, *Eucalia inconstans* Kirtland. Page 71.

Four-spine Stickleback—*Apeltes quadracus.* Mitchill

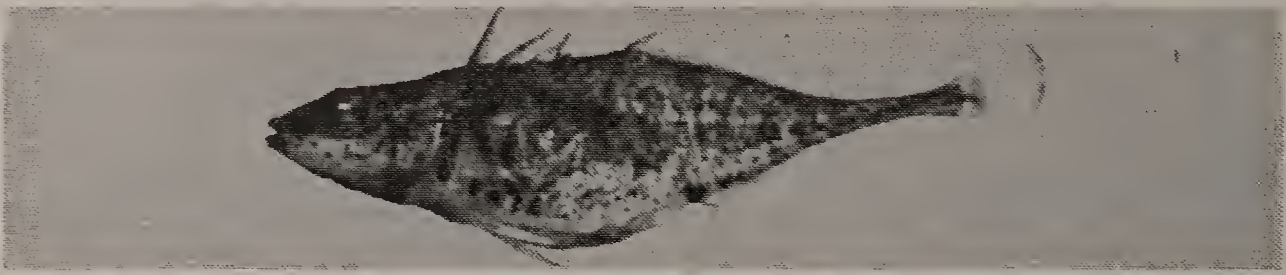


Figure 33. Four-spine Stickleback—*Apeltes quadracus.*

Other common names: Pinfish, Mud-pouch; Mud-perch.

Range: Prince Edward Island to New Jersey.

Occurrence in Nova Scotia: Vladykov and McKenzie say "Rather common along the coast of the whole region, being, however, almost exclusively a salt and brackish water species." It has been found in the course of the present investigation in a number of places far removed from the sea and possessing a rich freshwater fish fauna. Although it has not been found on Cape Breton Island as yet, it is probably to be expected in soft-rock regions throughout the province.

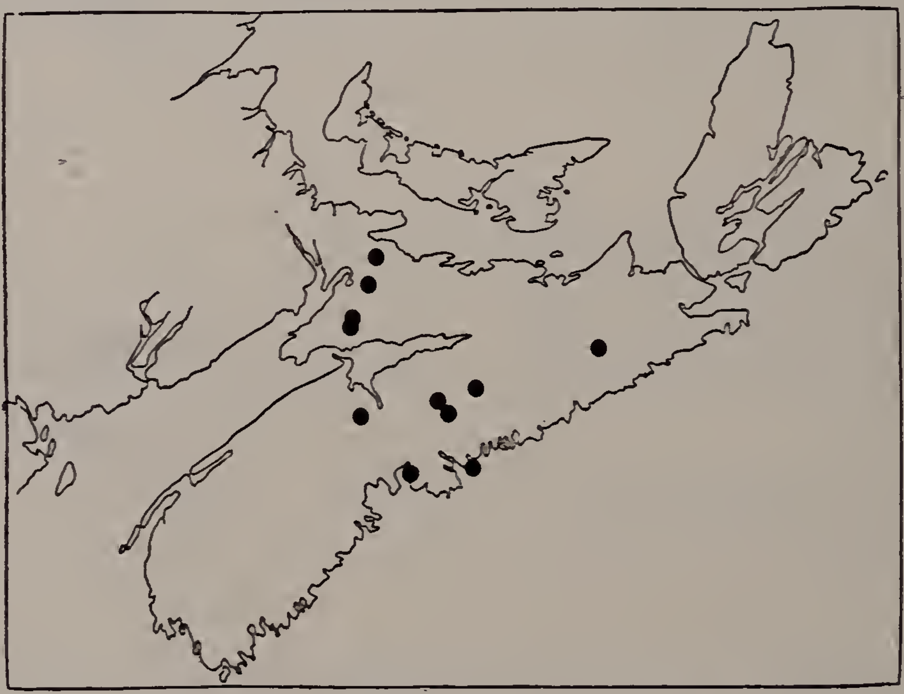


Figure 34. Distribution of Four-spine Stickleback—*Apeltes quadracus* in Nova Scotia.

Specimens in the Nova Scotia Museum of Science from:—

Cole Harbour, Halifax Co., N. S.	July 17, 1947
Gilbert Lake, Cumberland Co., N. S.	September 24, 1948
Fullerton Lake, Cumberland Co., N. S.	September 25, 1948
Goshen Lake, Guysborough Co., N. S.	August 3, 1948
Grant Brook, Hants Co., N. S.	June 12, 1949
Brook near Three-mile Plain, Hants Co., N. S.	July 13, 1950

Description: This Stickleback attains a length of less than 3 inches.

Cole Harbour, Halifax Co., N. S.	July 17, 1947
Lake o' Law, Inverness Co., N. S.	September 8, 1948
Middle River, Victoria Co., N. S.	September 7, 1948
River Inhabitants, Inverness Co., N. S.	September 5, 1948
Copper Lake, Antigonish Co., N. S.	August 1948

Three-Spine Stickleback—*Gasterosteus aculeatus.* Linnaeus.

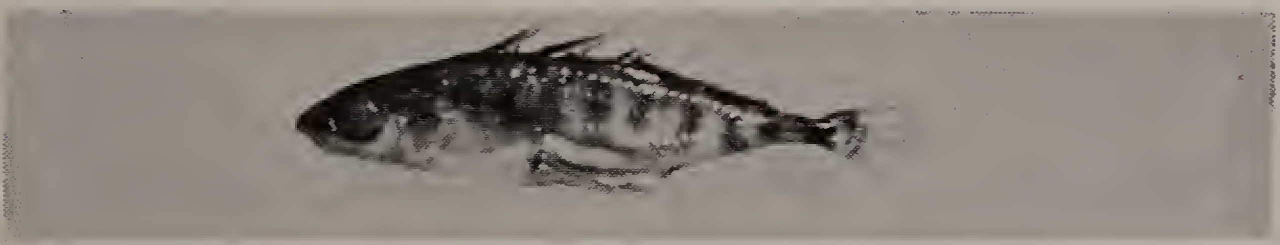


Figure 35. Three-spine Stickleback—*Gasterosteus aculeatus*

Other common names: Two-spined Stickleback; Common, European, Eastern, New York, Stickleback; Burnstickle; Tiddler; Pinfish.

Range: Salt and fresh waters of the Northern Hemisphere, south to northern Africa, northern China, Southern Japan, Lower California and Chesapeake Bay.

Occurrence in Nova Scotia: Throughout the rpovince except in the granite areas and on the plateau of northern Cape Breton.

Specimens in Nova Scotia Museum of Science from:—

Le Grand Lac, Grand Etang, Inverness Co., N. S.	1949
Little Lake, Grand Lake, Colchester Co., N. S.	1949
Grant Brook, Hants Co., N. S.	June 12, 1949

Description: In the spring Sticklebacks, including this species, construct an elaborate nest somewhat resembling that of an oriole. Fewer than a hundred eggs are usually produced, and these are zealously guarded by the male.

This is our largest Stickleback. It exceeds 3 inches in length.

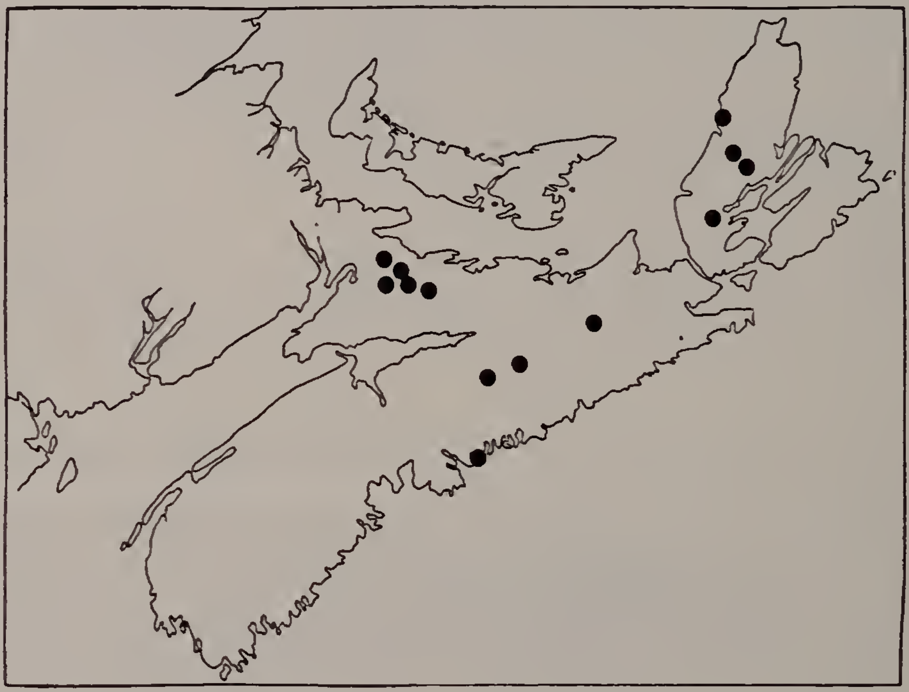


Figure 36. Distribution of Three-spine Stickleback—*Gasterosteus aculeatus* in Nova Scotia.

References: Hubbs and Lagler, 1947.

Nine-spine Stickleback—*Pungitius pungitius.* Linnaeus.

Other common names: Ten-spine Stickleback; Pinfish.

Range: Salt and fresh waters of the Northern Hemisphere, south to central Europe, the northern parts of China and Japan, Alaska and New Jersey.

Occurrence in Nova Scotia: The most widely distributed of our sticklebacks; it occurs throughout the province, in both granite and soft-rock areas, except on the plateau of northern Cape Breton. This is one of the larger sticklebacks; it grows to about 3 inches.

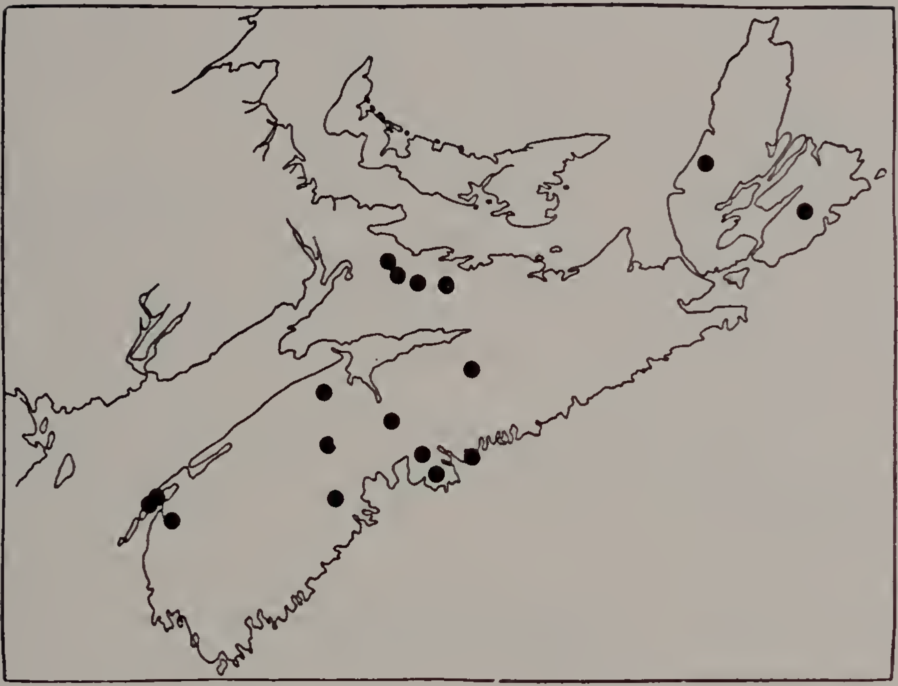


Figure 36. Distribution of Nine-spine stickleback—*Pugitius pungitis* in Nova Scotia.

Specimens in Nova Scotia Museum of Science from:—

Gully Brook, Lunenburg Co., N. S.	1946
Zwicker Brook, Lunenburg Co., N. S.	1946
Cole Harbour, Halifax Co., N. S.	July 17, 1947
Cranberry Lake, St. Margaret's Bay Road, Halifax Co., N. S.	August 4, 1947
Meteghan River, Digby Co., N. S.	July 27, 1949
Centreville Lake, Digby Neck, Digby Co., N. S.	July 24, 1949
Bog Hole, Digby Neck, Digby Co., N. S.	July 24, 1949
Lake Ainslie, Inverness Co., N. S.	September 9, 1948
Loch Lomond, Cape Breton Co., N. S.	September 26, 1948
Hubley Big Lake, Halifax Co., N. S.	June 24, 1948
LaHave River, Lunenburg Co., N. S.	June 20, 1948
Little Lake, Grand Lake, Hants Co., N. S.	September 1, 1949
Cameron Lake, Hants Co., N. S.	July 13, 1950
Ponds near Cornwallis River, Kings Co., N. S.	May 31, 1950

Brook Stickleback—*Eucalia inconstans.* Kirtland

Other common names: Common Freshwater Stickleback; Common Stickleback; Pinfish.

Range: British Columbia to the Maritimes (doubtfully from Greenland) south to Montana, Kansas, Illinois, Indiana, Ohio, Pennsylvania and New York.

Occurrence in Nova Scotia: The Brook Stickleback has not been encountered during the course of this investigation, but it is included here because of the possibility that it may be found in the province at some later date. It reaches a length of some $2\frac{1}{2}$ inches.

There are no specimens in the Nova Scotia Museum of Science collections.

GLOSSARY

adipose fin—a fleshy fin-like projection, without rays or spines, found on the backs ol some fishes behind the dorsal fin.

anadromous—running up streams to spawn.

anal—pertaining to the anus.

barbel—a fleshy projection, sometimes long and whiskery, sometimes short and fingerlike, found about the mouths of some fishes.

branchiostegal—a membrane supported by bony rays underneath the operculum of a fish.

caudal—pertaining to the tail.

compressed—flattened from side to side.

deciduous—falling out.

dorsal—pertaining to the back.

emarginate—slightly notched on the end.

heterocercal fin—the unsymetrical caudal fin of sturgeons and sharks, in which the vertebral column extends so far into the upper half that it is much bigger than the lower half.

homocercal fin—the type of caudal fin possessed by most fishes, in which the two halves, upper and lower, are of equal size.

innominate—a backward extending bone of the pelvic girdle.

isthmus—the narrow portion of the body projecting forward below the head and between the branchiostegals.

lateral band—a more or less prominent band of black pigment running along the midline of certain fishes, especially Cyprinidae.

lateral line—a line of sensory pores along the side of many fishes.

lateral line scale count—the number of scales along the lateral line (or the line where a normal lateral line would be, if it is absent) from the shoulder girdle to the structural caudal fin base, as determined without dissection by moving the caudal fin from side to side.

maxillary—the bone which forms most of the upper jaw.

pectoral fins—the paired fins of fishes just back of the head above and usually in front of the pelvic fins, The pectorals correspond to the forelegs of mammals.

pelvic fins—the second pair of ventral fins, usually behind the pectorals. They correspond to the hind legs of land vertebrates.

peritoneum—the membrane lining the abdominal cavity.

premaxillary—the bone forming the front portion of the upper jaw.

protractile—the term applied to the premaxillary bones of fishes when they may be drawn forward leaving a groove between them and the bones of the skull.

serrate—notched like a saw.

standard length—the distance from the most anterior part of the head (including both jaws) backward to the end of the vertebral column or structural base of the caudal rays.

subequal—almost the same size.

subterete—almost rounded.

terminal—at the end of the head.

total length—the greatest dimension between the most anteriorly projecting part of the head and the farthest tip of the caudal fin when the rays are squeezed together.

truncate—flat on the end.
vermiculate—covered with worm-like markings.
ventral—pertaining to the under side.
ventral fins—the unpaired fins usually placed behind the pelvic fins.
vomer—the bone which forms the roof of the mouth in a fish.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the invaluable assistance of the following people in the prosecution of this investigation:—

Dr. F. R. Hayes, of Dalhousie University, who first suggested the need for a comprehensive survey of Nova Scotia freshwater fishes, and who was a constant source of inspiration and advice.

Mr. D. K. Crowdis, of the Nova Scotia Museum of Science, who provided finances, equipment and vehicles, and allowed freedom from unnecessary supervision without which the work would have been impossible.

The many students of Dalhousie University, particularly Mr. Laurence Cameron and Mr. James Lewin, who acted as all-weather seining companions for four years.

Dr. J. R. Dymond of the University of Toronto, who placed his personal library and the collections of the Royal Ontario Museum of Zoology at the disposal of the author, and who very kindly verified the identity of the first year's collections.

Dr. Reeve M. Bailey and Dr. Karl F. Lagler of the University of Michigan and Dr. Ralph Hile of the U. S. Fish and Wildlife Service, who provided the use of their libraries as well as much useful information.

Dr. Hugh P. Bell of Dalhousie University, Dr. Carl L. Hubbs of the Scripps Institute of Oceanography and Dr. Edward S. Deevey, Jr., of Yale University, who provided many valuable ideas concerning the distribution of fishes and its relation to physiography.

Lastly, the people of Nova Scotia, who through their Museum of Science and their Inland Fisheries Survey provided the physical wherewithal to make this investigation possible and who, through their friendly and ready cooperation as individuals, made it a pleasure.

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THE ANALYSIS OF FORCE-AREA CURVES OF PROTEINS

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(Received for publication: March 6, 1952)

ABSTRACT

A method of analysis of the force-area curves obtained upon compression of monomolecular films has been presented; this method permits one to distinguish between two closely related species of protein molecules. Data obtained from the force-area curves are: 1. the surface pressure at which the curve becomes linear: 2. the slope of the linear portion of the curve; 3. the surface pressure at which the curve deviates from linearity in the direction of greater compressibility; 4. the specific area, obtained by extrapolating the linear portion of the curve to zero pressure. In addition the presence or absence of a solid fiber upon complete collapse of the film is recorded. The possible physico-chemical significance of these data are discussed; the fact that all these five data differ significantly before and after treatment of the protein with ultraviolet radiation shows that each of them has some definite relation to the physico-chemical properties of the film molecules.

The study of the surface chemistry of proteins was initiated by the French botanist, Devaux (1), and the Dutch paediatrician, Gorter (2); this latter worker and his collaborators first employed the Langmuir-type film balance to measure the one-dimensional 'force' or 'pressure' exerted by protein monomolecular films against a barrier floating on the surface of an aqueous phase. The data obtained upon compression of the film may be represented graphically in a plot of 'force' (dynes per cm., therefore dimensionally a tension) against specific area (sq. meters of film per mg. protein, or sq. Angstrom units per molecule, where the molecular weight of the protein has been well established.)

A typical force-area curve for egg albumin at the air/water interface is shown in Figure I. Several compressions and decompressions of this film are shown to illustrate the phenomenon of elastic hysteresis of protein monolayers (Langmuir and Waugh 3). The upper curve obtained upon decreasing the area of the film, shows three characteristic regions:

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[1] Aided by grants from the National Research Council and the Defense Research Board.

[2] Summer Fellow of the National Research Council.

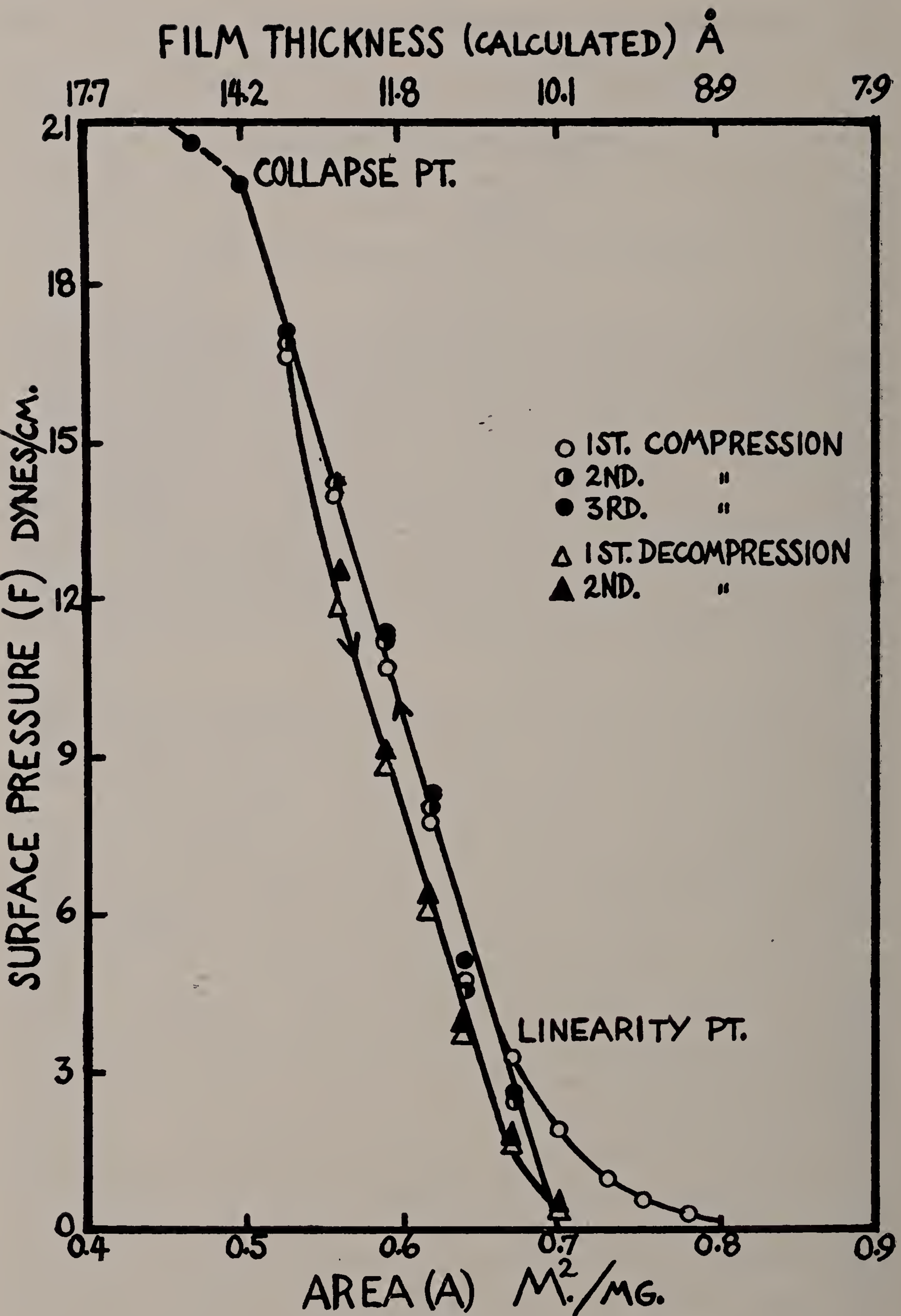

FIGURE 1

Compression and decompression curve for egg albumin. Extrapolated area at zero pressure is 0.7 m²/mg. Cenco 'hydrophil' balance used for surface pressure measurements. Film spread on distilled water buffered at pH 4.8.

1. At low pressure (under four dynes), there is a zone of relatively high compressibility, where decreases in film area lead to but small increases in surface pressure.

2. At about four dynes pressure, the curve becomes linear and remains so up to approximately twenty dynes. The linear portion of the curve represents the zone of lowest compressibility of the film; the pressure at which the curve becomes linear we have designated the 'linearity point'. Bull (9) has stressed his belief that these curves are only "approximately" *linear*; in using the term linear, we mean only that in this region of the force-area curve, a straight line best fits the experimental points (e.g. Figure 3). However, one is tempted to point out that the curves chosen by Bull to illustrate various of his articles (see 9) are as linear as any curves to be found in the scientific literature, including that describing the behaviour of ideal gases.

3. At approximately twenty dynes, the curve deviates from linearity in the direction of greater compressibility; this is the point at which the film begins to collapse. In the case of protein films, the collapse is not so spectacular as that of fatty acid films, but is quite gradual, as various restricted regions of the film 'buckle' separately. The collapse pressure might well have appeared somewhat lower had more sensitive methods of measurement (e.g. electrical or optical) been employed.

As the film is further compressed (not illustrated), more and more areas of the film collapse; these soon become visible as tiny striations running across the trough, parallel to the plane of compression. Upon complete compression, the monolayer is further crumpled up into a solid thread, or fiber, (Devaux effect, 4) resulting from the cramming together of the individual striations mentioned above; this fiber may easily be picked up from the surface of the water and is sturdy enough to survive considerable manipulation. The use of these fibers in the study of the biological properties of proteins has been described. (5, 6.)

The behaviour of the film at very low pressure (below one dyne) where its properties have been described as those of a two-dimensional gas (Guastalla, 7) was not studied, due to lack of the necessary instrumentation. From data obtained in this region, it is possible to calculate the molecular weight of various proteins (7).

In our work on protein monolayers, we record the following data:

1. *The specific area at zero pressure*, obtained by extrapolating the linear portion of the curve to the abscissa. This is a standard procedure in protein surface chemistry, introduced by Gorter and Grendel (8), permitting the comparison of one film with another, but is of no theoretical significance (Bull, 9).

2. *The linearity point*; it seems probable that the lower the pressure at which the curve becomes linear the greater the attractive forces that exist between the film molecules; this point may also be partially determined by the molecular weight or the molecular dimensions of the unfolded protein.

3. *The slope of the linear portion of the curve*; this is inversely related to the compressibility of the film. High compressibility (low slope) indicates that the film molecules are easily deformable (Adam 10). For the sake of convenience, all curves are considered to have a positive slope. The measurement of slope seems to have been introduced by Stallberg (11).

4. *The collapse point*; the collapse of the film is presumably due to the formation of inter-molecular linkages at higher film pressures. Here also, then, the lower the collapse pressure the greater the attractive intermolecular forces.

5. *The ability of the monolayer, upon complete collapse, to form a visible fiber.* The theoretical significance of this type of fiber formation is obscure; insulin, a protein of molecular weight close to that of egg albumin, does not form such a fiber (Wrinch 12). Nevertheless, in the experience of the senior author, the ability of a protein to form a fiber is related to its molecular weight, those of high M.W. forming such

fibers, but often losing their ability to do so upon a treatment so mild that their film-forming capacity is unimpaired.

Other film data, which are sometimes recorded, are the 'gel point' of Hughes and Rideal (13) and the 'coefficient of compressibility' of Bull (1).

The method of analysis outlined above has proven to yield extremely useful results in evaluating the action of physical and chemical agents on protein monolayers and on solutions of proteins. As an example, let us consider the effect of ultraviolet irradiation on a monolayer of protein. Gorter (15) has reported that UV will decrease at a uniform rate the area of such a film, due to destruction of the protein. Without an examination of the force-area curve of such an irradiated film, one might imagine that one is simply observing the elimination of the fragmented protein from the film, leaving the intact molecules still adsorbed, unchanged, at the interface. This, however, is not the case, as the residual film, after irradiation, is strikingly different in properties from the unirradiated control film.

This is illustrated in Figure 2, which shows the force-area curve of a protein film following a period of irradiation and in Figure 3, which represents that of an un-irradiated control. Table I summarizes the properties of these films with respect to the criteria discussed above; the two films presented were selected as typical.

TABLE I

Properties of irradiated and control monolayers

	Unirradiated control	Irradiated experimental
Extrapolated area (m^2/mg)	0.86	0.36
Linearity point (dynes/cm)	5.0	9.5
Slope $\frac{(\text{dynes. cm}^{-1})}{(\text{m}^2.\text{mg}^{-1})}$	72	112
Collapse point (dynes/cm)	20	34.5
Fiber formation	+++	—

The residual film after irradiation differs from the control in that its area is smaller, it has a much higher linearity point, it is of very low compressibility, it has a high collapse point,

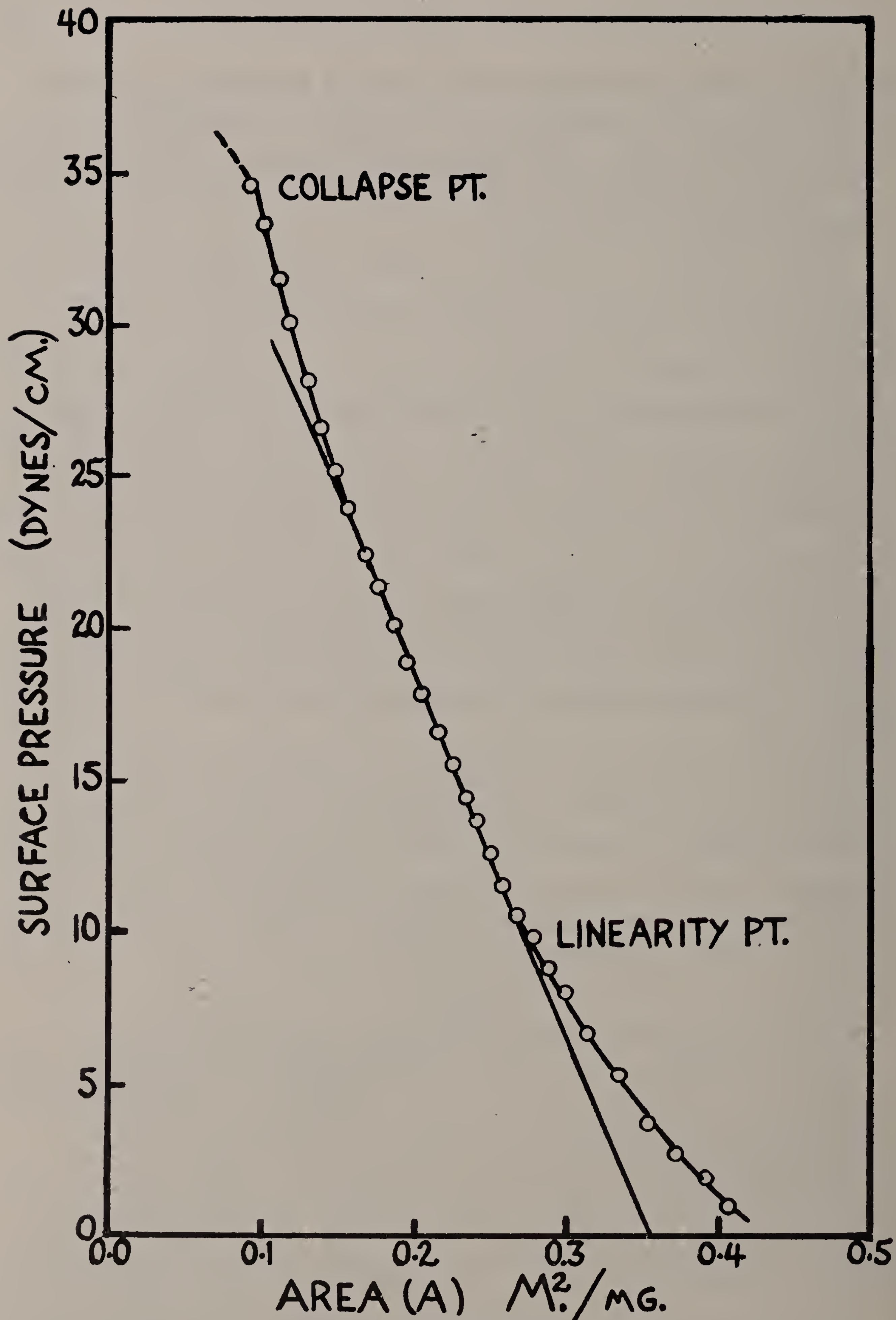

FIGURE 2
Force-area curve for an irradiated film. Note the inflection (in the direction of decreased compressibility) at approx. 23 dynes.

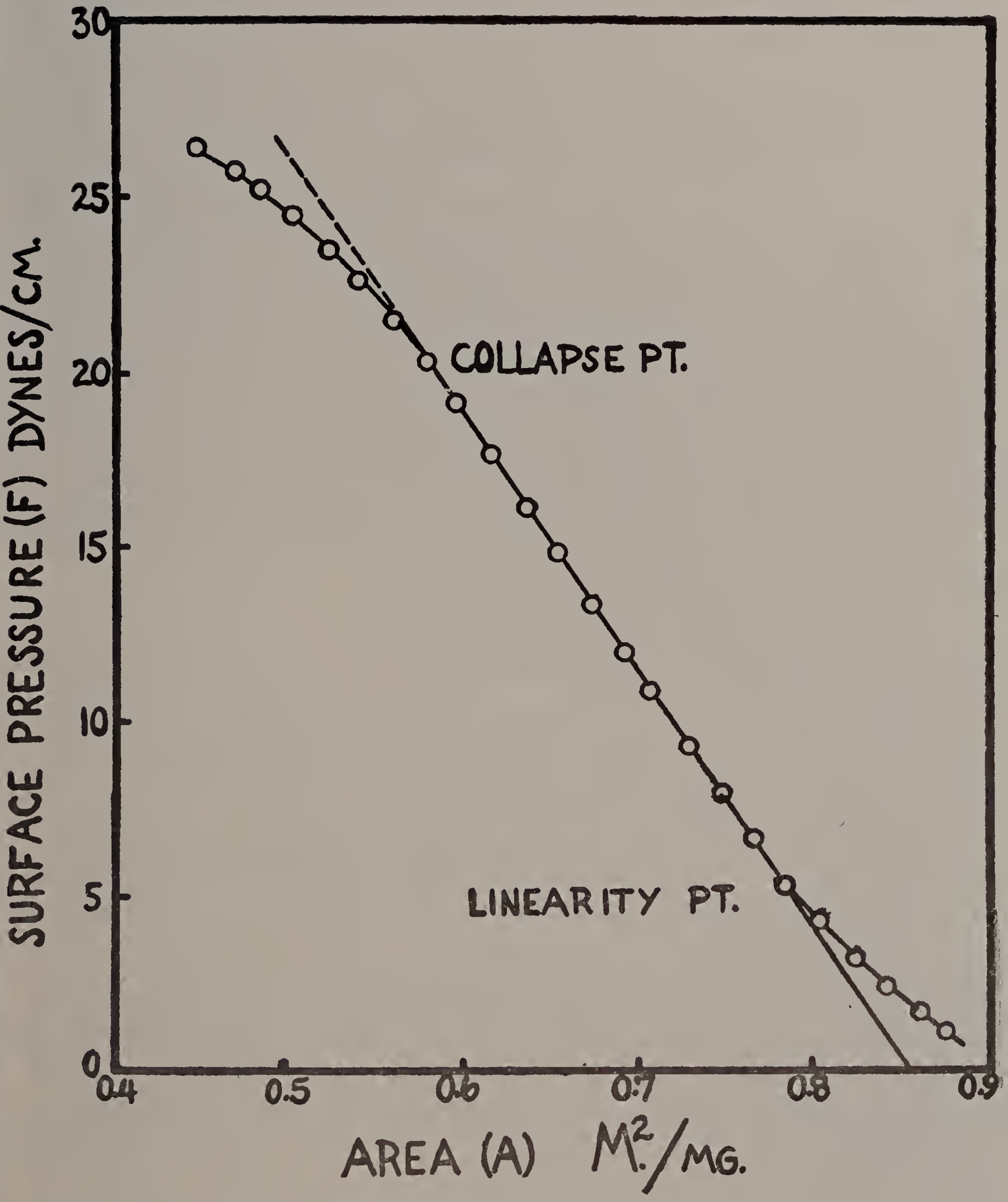

FIGURE 3
Force-area curve for an unirradiated control film

and it cannot form a fiber upon complete collapse. This last point is a genuine difference and does not follow from the fact that much of the protein has been lost from the interface due to the action of the UV. We may tentatively conclude on the basis of this analysis that the molecules of the irradiated film differ from those of the unirradiated film in that they are of lower molecular weight, are more rigid and less deformable, and in that the attractive forces between them are much less.

Two papers, describing application of this method to the study of the effect of UV on protein monolayers and on dilute solutions of protein, are in preparation (16, 17); exact experimental details and statistical treatment of data will be presented there. It is hoped that other workers may find this method useful in the analysis of the action of various physicochemical agents on protein, since it is effective even at protein concentrations of the order of 0.01%.

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PRESIDENTIAL ADDRESS

NOVA SCOTIAN INSTITUTE OF SCIENCE

C. B. Weld

89th Annual Meeting. October 23rd 1950

Members of the Institute:

According to the constitution it is my duty at this time to review the progress of the Institute during the past year and to discuss such topics as I may deem conducive to the welfare of the Institute. I will be brief. At the outset I am happy to be able to say that, to the best of my knowledge, none of our members have died during the year. If I should be mistaken, please inform me of the fact in order that a suitable addendum may be made to this report.

We have had an active year, holding a full complement of seven meetings at which twenty-one papers were presented. Twenty-seven authors contributed to these and the programs were well diversified and the presentations of good quality. The average attendance at the meetings was forty, a figure that indicates a continued interest on the part of our members and guests. As usual the great majority of the papers originated in Dalhousie University laboratories. This is as it should be, perhaps, Dalhousie being our most central Academic body. We have welcomed a number of Oceanographic papers this year and we would like to have more from other laboratories, such as to name a few—the Defence Research Board, N.R.E., the Fisheries, the N. S. Research Foundation, N. S. Technical College, the new department of metabolism at the V.G.H., the new National Research Council, etc. We must not fail to persuade our Halifax members from laboratories other than Dalhousie and our Associate members outside Halifax to present the results of their researches at our meetings. This year not one of our associate members availed himself of our offer to defray at least a part of his expenses should he wish to present his work at a meeting of the Institute. We must be more persuasive in the future and make a real effort to bring in outside papers. One of our constitutional objects is the promotion of scientific research. We can not pay the expenses of the research but we can foster it by creating an atmosphere at our meetings in which people interested in research can exchange ideas and obtain encouragement, and for their good as well as ours we must persuade the shy and diffident individual to come and take part in the scientific discussions.

There is nothing I would like better than to see your Council having to wrestle with the problem of handling a great increase in the number of papers offered. Indeed, in view of the increased research activity in this area, we can be rather disturbed if the problem does not arise. The suggestion that we organize sectional meetings, either by laboratories or by subjects, has already been voiced in informal discussions. The holding of separate, perhaps concurrent, meetings for papers in the biological and in the physical Sciences, for example, would certainly allow more papers to be presented and it might conceivably result in freer discussion of the papers. However, in my opinion, the more likely result would be that the papers would become more technical and the discussion more restricted in its scope. It may be that some divided meetings will soon be tried, but there is strength in our full meetings and I hope that they are not lightly dropped. However this is a matter we may safely leave to the wisdom of the future Councils.

Our membership remains at about two hundred of which seventy-seven are ordinary members, ten are life members, and about fifty are student members. I believe that few scientific workers doing research in this area are non-members but there must be some in other parts of the province who are not members. We must remember that we are a Provincial body and that almost our only contact with the province as a whole is through our associate members. We should give thought to our science colleagues who might become interested associates and nominate them.

I must not enroach upon the reports of officers that follow but a few remarks may be in order at this point. The treasurer will report that we have spent more than our income. For some years the volumes of the Proceedings were very slim and our expenses small and in those years we consciously accumulated a reserve that would help us through more expensive years. These are now upon us: our Proceedings are fatter and printing costs are high. Our financial position is good but more funds may be needed soon and your Council is watching the situation closely. We do not want to curtail our publications. The Corresponding Secretary will report a very healthy condition of exchanges. The Editor now has the 1948-49 part of the Proceedings in the hands of the printers and the current number largely assembled. We are now only one issue behind. The Librarian is at last able to report that the library is well organized and catalogued and that any volume or paper is now accessible, even those in the oldest back files. All these officers, together with the Recording Secretary, have worked tirelessly and efficiently and they deserve our especial thanks.

During the year there have been ten meetings of your Council. It is always surprising how many relatively minor problems present themselves in the course of the year and it is amazing how much time they take. I must congratulate your council on its ability to discuss these matters patiently and yet without undue waste of time. Only two matters are being specifically left to next year's council. One is the minor but ever recurring question of whether we should provide some timing mechanism with which to warn speakers of the elapse of their allotted time. During the past year your Council has become increasingly conscious of the need for a simple device routinely and impersonally applied to all speakers. The other matter is new. Towards the end of the year, at the suggestion of Dr. Begg, Council discussed the possibility of encouraging our student members to present papers before us. We cannot commit the new Council but we are recommending to them the establishment of two $50. prizes for this purpose. The suggestion is that one prize be given to the biological sciences group and one to the physical sciences group, and that it be awarded on the basis of both its oral presentation and its manuscript. The manuscript should be submitted to Council for judging only. If publication should be desired it would also be submitted to the editor in the usual way. I am sure that comments from any member would be welcomed by Council as a guide to follow in the formulation of rules and procedure in this matter.

You will have received recently, new copies of our "Constitution and By-Laws." The last issue of this booklet was in 1940 and the issue is now out of print. Your Council felt that a revision of the constitution was not required but it did consolidate the previous By-Law revisions and review them as a whole. A sufficiently large printing has been made to allow a copy to be furnished to each member and to leave enough over to last us many more years.

The research activity in this community and the number of scientific workers is rapidly increasing. To the Institute this poses a problem. Unless we grow in numbers and in activity to a corresponding degree we are actually losing ground. I have already spoken of the need of new members and of the possibility of extra meetings: this is the reason. I personally hate to think of the Institute getting large and unwieldy but we must expand with our community or die. We have had an active year and apparently a successful one but we have not expanded and perhaps we should have. I will not be satisfied that the Institute is truly healthy unless the coming Council suffers growing pains.

In closing I wish to thank each member of Council for conscientious attendance at meetings and for unfailing interest in all the Institute's affairs. In the normal course of events my term of office as President will end this evening. Though I give up the office thankfully I do wish to express my thanks for the honour you have done me in making me your President.

PROCEEDINGS OF MEETINGS

Session of 1950-51

(Meetings were held in the Medical Sciences Building,
Dalhousie University, Halifax, N. S., except that of
March 28 which was held at Acadia University,
Wolfville, N. S.)

89*th Annual Business Meeting*, October 23, 1950.

The President, Dr. C. B. Weld, presided with 21 members present. His annual address is printed in full in the proceedings.

Reports of Officers were presented and are summarized as follows:

Treasurer's Report;

Receipts	$ 859.21
Expenditures	1,047.59
Total assets, current account	1,946.62
Total assets, permanent fund	4,000.00

The Corresponding Secretary reported that a total of twelve new exchanges were set up during the year. Forty-three reprints were sold and five hundred and twenty copies of Vol. 22, Pt. 2, mailed, exclusive of members' copies.

The Editor reported that Part 2 of Volume XXII was published, Part 3 was in press and that Part 4 was ready for the printers.

The Librarian reported that a catalogue of our holdings is maintained by Miss Campbell, Librarian of the Nova Scotia Research Foundation.

Officers elected for the year 1950-51 were;

President	Dr. A. E. Cameron
1st Vice-President	Dr. W. J. Chute
2nd Vice-President	Dr. H. D. Smith
Treasurer	Dr. J. R. Dingle
Corresponding Secretary	Dr. J. G. Aldous
Recording Secretary	Dr. W. J. Dyer
Council	Dr. L. G. S. Newsham, Dr. W. L. Ford, Dr. C. B. Weld, Dr. J. A. McCarter and Mr. D. K. Crowdis

Editor	Dr. H. R. Chipman
Librarian	Dr. W. J. Chute
Auditors	Dr. R. J. Bean and Dr. H. L. Bronson

1st Ordinary Meeting, November 13, 1950.

The following new members were announced (elected by Council, October 23); ordinary members, N. G. B. McLetchie, M.D., R. W. Reed, M.D., M. M. Hoffman, Ph.D., M.D., F. J. Moya, B.Sc., R. A. Hornstein, M.A., R. D. Stewart, Ph.D., Mrs. R. D. Stewart, M.Sc., J. G. Kaplan, Ph.D., C. M. Harlow, Ph.D., M.D., E. P. Sidaway, B.Sc., J. E. Keystone, Ph.D., H. H. Waterman, M.Sc., D. E. Eagles, M.Sc., D. S. Willoughby, M.A.; student members, E. Harris, B.Sc., J. S. Tait, B.Sc., G. M. G. Bidwell, N. R. Beckett, Miss Shirley, McCoy, B.Sc., Miss Nancy E. Henderson, Miss Mary I. Rettie, B.Sc., F. A. Ferguson, B.Sc., G. M. Graham, M. J. Fraser, R. E. Green, A. L. Carter, Brooks Cann, B.Sc., G. Richardson, B.Sc., R. Ackman, B.A., J. F. Richards, B.A., D. G. Gage, B.Sc.

Papers; "Anaphylaxis and Acetylsalicylic Acid", by C. B. Weld and J. R. Baker; "The Specificity of Action of Iodoacetic Acid on the Enzymes of the Intact Yeast Cell", by J. G. Aldous; "A Conversion of Radioactive Carbon (14) from Carbonate to Cyanide," by J. A. McCarter.

2nd Ordinary Meeting, December 11, 1950.

D. H. Andrews, B.Sc., and W. D. Jamieson, B.Sc. were announced as new student members (elected by Council, November 17).

Papers; "Determinate Growth in the Blueberry", by H. P. Bell and Jane M. Bailly; "A General Method for the Mobility Determination of Mobility Distribution of Proteins", by P. M. Laughton; "Assessment of Physiological Age by Combination of Several Criteria—Vision, Hearing, Blood Pressure, and Muscle Force", by I. M. Murray.

3rd Ordinary Meeting, January 8, 1951.

The following new student members were announced (elected by Council, January 8); D. Sampson, R. MacDonald, B.Sc., E. Aitken, J. Sproul, E. Collins, B.A., J. M. Bruce, B.A., H. Revington, F. Bent, S. Love, L. Aalders, W. Fortune, S. Bleakney, B.Sc., Miss Claire Killam, Miss Joan McGowan, Miss Ann Woodworth, Miss Katherine Livingstone, and Miss Janet Clarke.

Papers; "The Lymphocytopenic Effect of Type II Pneumococcus", by R. D. Stewart and L. Stewart; "Trimethylamine Oxide in Fish," by W. J. Dyer; "A Study of the Effect of Weather on Coastal Water Conditions off Halifax, Nova Scotia," by R. E. Banks and J. R. Longard.

4th Ordinary Meeting, February 12, 1951.

Papers; "Centrifugation and Chemical Fractionation of the Lipids of Lipemia", by C. B. Weld and P. C. Gordon; "The 1950 Six-ship Survey of the Gulf Stream", by W. L. Ford; "Influence of Geometry on Geiger Counter Characteristics", by L. G. S. Newsham.

5th Ordinary Meeting, March 12, 1951.

E. O. Cook, Ph.D., was announced as a new ordinary member (elected by Council March 12).

Papers; "The Freshwater Fishes of Nova Scotia," by D. A. Livingstone; "The Lepidoptera of Nova Scotia. Pt. I. Macrolepidoptera", by D. C. Ferguson; "Synthesis of Benzene Labelled with C^{14}, by F. K. MacMillan and J. A. McCarter.

6th Ordinary Meeting, March 28, 1951. (Held at Acadia University, Wolfville, N. S.)

Papers; "A Local Glacier in the Annapolis-Cornwallis Valley," by R. H. MacNeill and C. A. Purdy; "A Cytological Study of the Oral Glands of the Fowl, *Gallus domesticus*", by D. J. McCallion and H. E. Aitken; "A Study of the Boreal Forest Formation in Nova Scotia", by E. H. Collins and E. C.

Smith; "Differential Sensitivity of the Mitotic Prophase in Tradescantia to X-radiation. I. Pollen Grains. II. Pollen Tubes", by C. J. Bishop, A. D. Woodworth and L. J. McGowan.

7th Ordinary Meeting, April 9, 1951.

The following new associate members were announced, J. S. Erskine, M.A., and W. Schofield, B.Sc.

Papers; "Behaviour of Cytoplasmic Constituents During Spermatogenesis", by M. L. Cameron; "The Effect of the Isomeric Transition in Br^{80} on the Reactivity of Bromine with Chlorides of the Group IV Elements", by W. D. Jamieson; "Precision Determination of Nuclear Gyromagnetic Ratios," by E. W. Guptill, W. J. Archibald and E. S. Warren.

8th Ordinary Meeting, May 7, 1951.

R. P. Longley was announced as a new associate member (elected by Council April 9).

Papers; "A Cytological Study of the Germ Cells in *Deroceros reticulatum*, Muller", by Hope Bridgeford; "Demonstration of the Use of the Jenkin Surface Mud Sampler", by M. L. Cameron; "Enzymatic Activity as an Indication of the Intracellular pH of the Yeast Cell", by J. G. Aldous and K. D. Stewart.

ABSTRACTS

(Papers read before the Institute but not published in the Proceedings.)

ANAPHYLAXIS AND ACETYLSALICYLIC ACID. C. B. Weld and J. R. Baker, Physiology Dept., Dalhousie University, Halifax, N. S. (Read November 13, 1950). It has been confirmed and also refuted that acetylsalicylic acid (ASA) will prevent the development of anaphylactic shock in rabbits. Rabbits and guinea pigs were sensitized by the intravenous injection of egg albumin and examined for sensitivity 3 or more weeks later. Tissues taken under anaethesia before the shock dose was given were tested in vitro for sensitivity to the antigen. Only 3 gut and one uterus of gut, uterus epididymis, spleen, lung and urinary bladder showed a positive reaction, which could largely be prevented by the addition of 4 mg. per 100 ml. ASA to the bath.

Six of the sensitized rabbits were given intracutaneous injections of the antigen. None showed a sensitivity reaction even though the animals were demonstrated by a later intravenous injection to be sensitive. Twelve rabbits were given repeated subcutaneous injections of antigen in order to develop the "Arthrus phenomenon". No difference could be detected when six of these were given daily doses of 5 g. ASA.

Arterial blood pressure changes were obtained in eighteen of twenty-one sensitized rabbits during intravenous injection of shock doses of antigen, whereas four of five similar rabbits protected by 10 grains of ASA by mouth failed to show sensitivity. In guinea pigs all thirteen sensitized animals showed extreme bronchiole constriction whereas four of six protected by 20 grains ASA by mouth failed to show any marked effect.

It seems that ASA may prevent the anaphylactic shock in mildly sensitive animals as rabbits, and the extremely sensitive guinea pigs. However the doses were huge and smaller doses were not effective. There is no evidence that sensitivity reactions in general are effected and it is doubtful if the reaction has any practical significance.

THE SPECIFICITY OF ACTION OF IODOACETIC ACID AS DETERMINED BY ITS EFFECT ON THE ENZYMES OF THE INTACT CELL. J. G. Aldous. Dept of Pharmacology, Dalhousie University, Halifax, N. S. (Read November 13, 1950). Monoiodoacetic acid is often referred to as a "specific metabolic inhibitor" and has been widely used for investigating cellular metabolism. Previous methods have provided information on the sensitivity of enzymes after extraction, there is no indication of the mode of action on enzymes inside the intact cell. Under suitable conditions iodoacetic acid may be made to act in an irreversible manner, its effect on the cell persisting after exposure. Resting suspensions of *S. cerevisiae* were treated with iodoacetic acid, 1.5 x 10^{-3} M. at pH 4.5 for 30 minutes. This reduced the population viability to 20 percent by actual counts. After washing and drying the cells, the following enzyme systems were extracted and evaulated; cozymase, carboxylase, lactic dehydrogenase, alcohol dehydrogenase, and catalase. All showed an almost total loss of activity after exposure.

Thus iodoacetic acid has under these conditions a nonspecific action upon the yeast cell enzymes. Since two of these enzymes lack sulfhydryl groups, the usually accepted explanation of the mode of action of the poison (by combination with SH compounds) is not universally tenable at least not when exposure is made at a pH less than 5 rather than at neutral pH.

A CONVERSION OF RADIOACTIVE CARBON[14] FROM CARBONATE TO CYANIDE. J. A. McCarter, Biochemistry Dept., Dalhousie University, Halifax, N. S. (Read November 13, 1950). Long lived radioactive carbon (C^{14}) presently is being supplied as a solution of sodium carbonate or as solid barium carbonate. The importance of the cyanide radical in organic syntheses makes it necessary to have methods of converting carbonate to cyanide simply, efficiently and inexpensively. Present methods have proved to be unsatisfactory when judged by these standards. In the present work cyanide was prepared from carbonate in 90% yield by heating a mixture of potassium carbonate and zinc dust in a stream of ammonia and its decomposition products for four hours at 650 ± 20°C.

DETERMINATE GROWTH IN THE BLUEBERRY. Hugh P. Bell and Jane M. Bailly, Botany Dept., Dalhousie University, Halifax, N. S. (Read December 11, 1950). Elongation of the vegetative branch of the blueberry ceases early in June due to the death of both the apical meristem and the distal portion of the axis. Coincident with this, is the development of a flowering branch primordium in the axil of the penultimate leaf. During July, the apical meristem of the flowering branch becomes inactive. It is either laterally displaced or it elongates as a minute unbranched columnar structure. Coincident with this inactivation, the proximal flower promordia develop florets in which all flower parts may be recognized. but the distal flower primordia, that is those adjacent to the inactivated apical meristem, are retarded in their development. The retarded distal flower primordia are devoloped in succession but the proximal flower primordia do not exhibit acropetal succession. All the stages are illustrated by line diagrams.

A GENERAL METHOD FOR THE DETERMINATION OF MOBILITY DISTRIBUTIONS OF PROTEINS. P. M. Laughton, Chemistry Dept., Dalhousie University, Halifax, N. S. (Read December 11, 1950). A general method is given for the determination of the mobility of proteins at or near the average isoelectric point. The method can be used regardless of whether the diffusion coefficients vary among the protein molecules. The mobility distribution is a complete and objective description of the electrophoretic heterogeniety which is independent of the field strength and duration of the experiment.

Experimental limitations are discussed, including the effects of pH and conductivity variations in the spreading boundary, and of interaction among protein molecules. The method is illustrated by application to a number of native and modified serum albumins. The only distributions reported heretofore have been obtained for materials with a Gaussian distribution, which excludes many native and all chemically reacted proteins.

ASSESSMENT OF PHYSIOLOGICAL AGE BY COMBINATION OF SEVERAL CRITERIA—VISION, HEARING, BLOOD PRESSURE AND MUSCLE FORCE. I. M. Murray, Anatomy Dept., Dalhousie University, Halifax, N. S. (Read December 11, 1950). The usual methods of expressing age in terms of physiological function do not enable one to combine the various functions to give a single index of physiological age. A method is presented based on the examination of 5 physiological functions in a sample of thirty-eight men between the ages of 21 and 84 years. Age is expressed in terms of a combination of the five physiological functions and their squares. The method can be used with an unlimited number of physiological, anatomical and psychlogical criteria. The distribution of the deviations between the estimated physiological ages and the chronological ages of the thirty-eight men indicates that the question is equally applicable at all age periods. The standard error of the estimated physiological age was 7.35 years and the question was raised whether one could expect to reduce this variation with a larger sample and testing many more features.

The Lymphocytopenic Effect of Type II Pneumococcus. R. D. Stewart and L. Stewart, Biochemistry Dept., Dalhousie University, Halifax, N. S. (Read January 8, 1951). Certain strains of Type II Pneumococcus appear to elaborate a substance which causes a fall in the number of circulating lymphocytes in the adrenalectomized rat. A method of assay suitable for this and similar substances was presented together with data on the partial purification of the lymphocytopenic substance. (Thanks are due to Dr. J. Loefer, Foundation of Applied Research, San Antonio, Texas, and Dr. G. Pincus, Worcester Foundation for Experimental Biology, for facilities and cooperation).

Trimethylamine Oxide in Fish. W. J. Dyer, Atlantic Fisheries Experimental Station, Halifax, N. S. (Read January 8, 1951). The trimethylamine oxide content of eighty-five species of fish has been determined and the results expressed on both the wet and dry basis.

The elasmobranchs contain 2 to 4 percent (based on dry weight), considerably more than the teleost fish. Freshwater fish contain no trimethylamine oxide and in general the amount increases from the lower to the higher orders of the teleost fish. The metabolism of the oxide in fish was discussed.

A Study of the Effect of Weather on Coastal Water Conditions off Halifax, Nova Scotia, R. E. Banks and J. R. Longard, Naval Research Establishment, Halifax, N. S. (Read January 8, 1951). A correlation has been made between the structure of the water column along the coast of Nova Scotia and the direction, force and duration of the wind based upon twice daily bathythermograph observations taken by Sambro Light Vessel. This vessel is located in 50 fathoms of water 10 miles off shore in the vicinity of Halifax, N. S. It is shown that, if the winds at the Light Vessel have an easterly component and blow with force 6 to 10 for more than half a day or with force 4 to 5 for several days, a shoreward movement of surface water occurs which fills the water column, dsplacing the bottom water. The effect is not one of mixing of upper and bottom waters nor does it appear to be due to the mere presence of a low pressure area in the vicinity. For example, tropical hurricanes, which in passing by just beyond the Scotian Shelf did not produce the necessary wind conditions, caused no change in the water pattern of the Light Vessel.

CENTRIFUGATION AND CHEMICAL FRACTIONATION OF THE LIPIDS OF LIPEMIA. C. B. Weld and P. C. Gordon, Physiology Dept., Dalhousie University, Halifax, N. S. (Read February 12, 1951), Alimentary lipemia was produced in dogs by feeding 30 ml. cod liver oil. After 2-3 hours blood is taken, centrifuged briefly to remove the cells, and the lipemic plasma removed. The plasma was then centrifuged at 6000 g. for one hour and separated into an optically dense upper layer and a clear lower layer. The original normal plasma, the lipemic plasma, the upper and lower layers of the centrifuged plasma, and plasma after clearing by injection of heparin, were examined microscopically and then fractionated as follows. The free lipid was determined by ether extraction, and the remaining combined lipid then determined by alcohol-ether extraction. The total lipid phosphorus was also determined.

A moderate increase in all lipid fractions was obtained with lipemia; this was little reduced by heparin. The centrifugation concentrated the free and combined fractions equally but the lipid phosphorus was much more concentrated in the top layer, where the chylomicrons are most numerous. It is concluded that phospholipids are an important constituent of the chylomicrons of alimentary lipemia. These are the particles that are dissipated by heparin injection.

THE 1950 SIX-SHIP SURVEY OF THE GULF STREAM. W. L. Ford, Naval Research Extablishment, Halifax, N. S. (Read February 12, 1951). The objectives, plan of operation and some of the results of the first multiple ship oceanographic survey of the Gulf Stream in the region between Cape Hatteras and the Grand Banks are reviewed. A unique feature was a co-odrinating group of scientists located on one of the ships which on the basis of information supplied by radio every six hours from all ships issued instructions as to preferred line of action for each ship. This procedure which made it possible to put ships where they were most needed added greatly to the success of the survey. The following aspects of the Gulf Stream as observed during the cruise are discussed; the path of the Stream and its lateral rate of movement, the formation of a massive cyclonic cold-centered eddy, the parallelism of isotherms and current directions in the upper 200 meters.

INFLUENCE OF GEOMETRY ON GEIGER COUNTER CHARACTERISTICS. L. G. S. Newsham, Physics Dept., Dalhousie University, Halifax, N. S. (Read February 12, 1951). A study has been made of a Geiger-Mueller counter by varying the anode length and diameter and cathode diameter The electrical pulses from the anode due to a steady ionizing radiation have been displayed on a high speed oscilloscope with sweep speeds up to 2.5 x 10^6 cm. per sec. and also counted on a scaler. The characteristics studied were threshold, plateau length, pulse size and resolving time. Curves showing the dependence of these characteristics on geometrical factors have been prepared and a considerable reduction of operating potential with reduced anode and cathode diameters has been demonstrated as well as a reduction in resolving time with reduced cathode diameter. The introduction of a grid so that these advantages may be attained without loss of efficiency or restriction on the cathode shape has been made. In all experiments, a filling mixture of argon and ethanol has been used.

THE LEPIDOPTERA OF NOVA SCOTIA. PART I, MACROLEPIDOPTERA. D. C. Ferguson, Nova Scotia Museum of Science, Halifax, N. S. (Read March 12, 1951). A brief account is given of approximately eight hundred and twenty species recorded from this region, not primarily for identification purposes, but rather to record the ranges of the various species within Nova Scotia. The host plants are mentioned when known. The type localities as well as references to the original descriptions are given for all species or races described from Nova Scotia. Photographs of the holotypes and allotypes are also given. Photographic halftone reproductions are included of many species rarely, if ever, figured previously.

The distributional and taxonomic studies involved in the preparation of this paper indicate that Nova Scotia occupies an interesting position between an almost typically New England coastal flora and fauna, and the Canadian Spruce Belt, stretching across the north from coast to coast. Its proximity to the northern coniferous belt gives Nova Scotia a link with the west, for a number of species described from Alberta and British Columbia have turned up here. Definite elements of the subartic, post-glacial fauna are still in evidence, and colonies of several species hitherto known only from Labrador occur here. Another factor influencing our insect fauna is the almost complete isolation by water of Nova Scotia from the mainland. This seems to have resulted in the development of a number of peculiar and interesting geographical variants.

SYNTHESIS OF BENZENE LABELLED WITH C^{14}. F. K. MacMillan and J. A. McCarter, Biochemistry Dept., Dalhousie University, Halifax, N. S. (Read March 12, 1951). A synthesis of benzene labelled in one carbon atom with radioactive carbon was undertaken preparatory to a study of the metabolism of this substance in the rat. Potassium carbonate C^{14} was converted to potassium cyanide. This was reacted with pentamethylane bromide and the resulting 1,5-dicyanopentane hydrolyzed with concentrated hydrochloric acid to pimelic acid. The diethyl ester of this as cyclized using sodium in a Dieckmann condensation and the resulting ethyl ester hyrodolyzed with dilute hydrochloric acid to cyclohexanone. This was converted to cyclohexane by Clemmensen reduction and this in turn to benzene in a vapour phase dehydrogenation over palladium black.

The yield of benzene based on penta methylene bromide (0.038 moles) was 30 percent. Because of the loss of one-half of the radioactive carbon in the decarboxylation of thebeta-keto acid the yield of benzene based on potassium cyanide was 15 percent. However the carbon dioxide eliminated may be recycled.

A LOCAL GLACIER IN THE ANNAPOLIS-CORNWALLIS VALLEY. R. H. MacNeill and C. A. Purdy, Acadia University, Wolfville, N. S. (Read March 28, 1951). After the passage and subsequent retreat of the Labrador ice sheet the climate of the area that is now Nova Scotia became considerably colder and local ice caps formed. The proposed area of one such accumulation was in a southerly direction from Middleton, possibly in the area around Skull Bog Lake. The ice spread to the northwest, north, and northeast to the Annapolis-Cornwallis Valley and also rode up on North Mountain. The glacial ice flow was not extensive, but evidence shows that it reached at least as far as Granville Centre to the northwest and to Coldbrook. During its advance there was a considerable reworking of the valley deposits as well as either the formation of drumlins or the reforming of previously deposited drumlins in the vicinity of the Medway River and Frog Lake, giving these drumlins an east-west orientation, as opposed to the orientation of drumlins formed by the Labrador ice sheet. Some boulder pavement, consisting of South Mountain granite, was slid down in various areas from Granville Center to Grafton, and ice margin features are prevalent in the Millville to Coldbrook area, suggesting that this area was near the margin of the ice sheet.

A CYTOLOGICAL STUDY OF THE ORAL GLANDS OF THE FOWL, GALLUS DOMESTICUS. D. J. McCallion and H. E. Aitken, Acadia University, Wolfville, N. S. (Read March 28, 1951). The present study was made on the anterior submacillary oral gland (glandula inframaxillaris interna) for the domestic chicken at 1 day, 4 days and 10 months of age. This gland is one of a number of aggregates distributed throughout the mouth and along the oesophagus. It is a compound tubular gland whose ducts open in several places under the tongue. The glandular epithelium is composed of a single layer of tall prismatic cells. There is but one type of cell present—mucous cells, and no serous cells. Although the animals were sacrificed while feeding continuously, many of the cells are loaded with mucigen and the nuclei are flattened at the bases of the cells. A number of cells are seen in various stages of secretory activity. No mitotic figures were seen at any stage. The cytoplasm is stringly, basophilic, which may be in part ribo-nucleic acid, but is probably largely mucoproteins. Tests for alkaline phosphase were negative but a strongly positive acid phosphase test was obtained. The Golgi apparatus appears to be a small, supranuclear network. Its position and form varies with the secretory activity of the cell in agreement with two previous workers.

A STUDY OF THE BOREAL FOREST FORMATION IN NOVA SCOTIA. E. H. Collins and E. C. Smith, Acadia University, Wolfville, N. S. (Read March 28, 1951). The relationship of the forests of the CapeBreton plateau to those of the neighbouring forest regions of Eastern Canada has long been in doubt. According to Macoun, Fernow, and more recently Halliday, these forests are not of a boreal nature. Nichols, in 1918, however placed the Plateau forests in the Northern Coniferous or Boreal Forest formation. Further study during the summers of 1948-50 using aerial photographs and ground traverses mapped the forests north of the Cape Breton Highlands National Park boundary. The forests are shown to be of the Boreal Forest Formation consisting of a Balsam fir and a Black Spruce Consociation.

The principal arboreal species, *Abies balsamea*, *Picea mariana* and *P. glauca*, and *Betula papyrifera*, are characteristic of the Boreal Forest. The ground cover species, such as *Cornus canadensis*, *Maianthemum canadense*, *Trientalis borealis*, and *Aralia nudicaulis*, and the mosses *Pleuroxium Schreberi*, *Hylocomium splendens*, and *Hypnum cristacastrensis*, while widely distributed, are also typically present in boreal forests. Furthermore the northern affinities of the vegetation of the plateau as a whole are shown by the presence of such species as *Viburnum edule*, *Betula pumila* and *B. borealis*, *Vaccinium uliginosum* var. *Alpinum*, *Empetrum Eamesii* and *E. atropurpurem*, and *Amelanchier Bartraiana*.

DIFFERENTIAL SENSITIVITY OF THE MITOTIC PROPHASE IN TRADESCANTIA TO X-RADIATION. 1. POLLEN GRAINS. 11. POLLEN TUBES. C. J. Bishop A. D. Woodworth and L. J. McGowan, Acadia University, Wolfville, N. S. (Read March 28, 1951). Radio-biological research has shown that the sensitivity of chromosomes to X-radiation changes during successive stages of the mitotic cycle. Experiments are described to determine the nature and range of this change from resting stage to late prophase. Investigation was carried out at two different stages in the development of the pollen grains of *Tradescantia paludosa.* X-ray doses of 100r were given at 40 r.p.m. at a voltage level of 140 Kv. and 5 MA. In Part 1, cut inflorescences were irradiated (100r) at intervals from the resting stage to midmitotic prophase of the pollen grain division and analyzed at the metaphase and anaphase stages immediately following. Acetocarmine smears were prepared at 2 to 6 hour intervals from 24 to 48 hours after X-raying. Part 2 involved irradiating inflorescences with 160r during the resting stage and prophase following the pollen grain mitosis. Pollen dehiscing at 12 to 24 intervals from 24 to 120 hours following irradiation was cultured on a 12 percent lactose-agar medium, including 0.01 percent colchicine. The pollen tubes were fixed and stained with acetocarmine after 18 hours growth, and the effects of the radiation analysed at the metaphase of the generative nucleus division.

Results indicate that the sensitivity increases as the prophase stage progresses. A detailed study at the time of chromosome doubling shows that this process has an important effect on the type of aberations produced and their frequency.

BEHAVIOUR OF CYTOPLASMIC CONSTITUENTS DURING SPERMATOGENESIS IN TENEBRIO. M. L. Cameron, Biology Dept., Dalhousie University, Halifax, N. S. (Read April 9, 1951). By means of phase microscopy the evolution of mitochondria into nebenkerne and mitochrondrial sheaths, the development of the acroblast and acrosome and the role of the centriole have been studied and photographed in the developing sperms of the mealworm, *Tenebrio.* Comparison with materials prepared by standard cytological methods shows that phase microscopy presents a reliable and more complete picture of the cell than any of the classical methods.

THE EFFECT OF THE ISOMERIC TRANSITION IN Br^{80} ON THE REACTIVITY OF BROMINE WITH TETRACHLORIDES OF THE GROUP IV ELEMENTS. W. D. Jamieson, Chemistry Dept., Dalhousie University, Halifax, N. S. (Read April 9, 1951). This research extends and confirms present knowledge of the effect of the isomeric transition in Br^{80} on the reactivity of bromine with solvent molecules. The effect on the reactivity in the liquid phase at room temperature with the tetrahedral Group IV tetrachlorides was investigated. 34 percent of the isomeric transition processes were effective in bringing about reaction between the lower isomer of Br^{80} and the carbon tetrachloride, while with silicon tetrachloride the efficiency was 45 percent and with germanium tetrachloride the process was 19 percent efficient. Any effect on the reactivity with tin tetrachloride was masked by easy and rapid exchange of bound and free halogen under the experimental conditions. The carbon, silicon and geranium tetrachlorides did not exchange halogen with free halogen to any appreciable extent. Experimental results have cast doubt on the accepted value of the half-life for the decay of the lower Br^{80} isomer. The efficiency of the isomeric transition activated reaction is discussed in relation to molecular properties.

PRECISION DETERMINATION OF NUCLEAR GYROMAGNETIC RATIOS E. W. Guptil, W. J. Archibald, and E. S. Warren. Physics Dept., Dalhousie University, Halifax, N. S. (Read April 9, 1951). The ratio of the Larmour frequency of precession for hydrogen and fluorine, and for sodium and aluminum have been measured with an accuracy of one part in 10^5;

$$\nu H/\nu F. = 1.062917 \pm 0.00001$$
$$\nu Na/\nu Al = 1.015081 \pm 0.00001$$
$$\nu Li/\nu P. = 1.041591 \pm 0.00002$$

A brief description is given of the relevant equipment used in obtaining these measurements.

A CYTOLOGICAL STUDY OF THE GERM CELLS IN *Deroceras Reticulatum*, Muller. Hope Bridgeford, Biology Dept., Dalhousie University, Halifax, N. S. (Read May 7, 1951). In this hermaphroditic mollusc, the sperm and eggs develop side by side in the same follicule of the ovotestis. The oogonia, from the time they become distinguishable from the undifferentiated germ cells, possess two oxyphilic nucleoli. During growth one of these nucleoli doubles in size and becomes basoplilic, budding off several small oxyphilic spheres, and later fragmenting. The smaller oxyphilic nucleolus remains constant throughout development. In spermatophytes, two oxyphilic nucleoli have also been found, which persist to late prophase and then disappear.

Exposure of animals to 0°C, from 1 to 192 hours caused the following changes; the germinal epithelium increased in size and elongated toward the centre of the follicule, there was a degeneration or complete disappearance of cytoplasm in many eggs, the largest nucleolus exhibited greater fragmentation especially in young oocytes while the oxyphilic nucleolus often became oval and migrated to the periphery and sometimes appeared slightly basophilic.

Injection of animals with Synapoidin caused a general lack of organization in the follicule; the eggs doubled in number and a degeneration of the cytoplasm of the eggs resulted in many cases. Injection with Colchicine suppressed the anaphase movements of the chromosomes for a certain length of time and increased the number of metaphase plates.

DEMONSTRATION OF THE USE OF THE JENKIN SURFACE MUD SAMPLER. M. L. Cameron, Biology Dept., Dalhousie University, Halifax, N. S. (Read May 7, 1951). With the Jenkin surface mud sampler it is possible to bring from the bottom of a lake a sample of mud and water, with no disturbance of stratification. The use of the sampler in the Zoological laboratory will be outlined.

ENZYMATIC ACTIVITY AS AN INDICATION OF THE INTRACELLULAR pH OF THE YEAST CELL. J. G. Aldous and K. D. Stewart, Pharmacology Dept., Dalhousie University, Halifax, N. S. (Read May 7, 1951). Determinations of the fermentative activity of Lebedev juices prepared from the cells of *S. cerevisiae* indicate that a reduction in the pH of the medium from 6.0 to 4.5 is accompanied by a considerable decrease in enzyme activity. On the other hand, the fermentative activity of whole cells remains essentially unaltered by hydrogen ion concentrations within this range. This would suggest that in order for the cozymase system to function actively the intracellular pH must be close to 6.0. This value agrees with that of 5.5 - 6.1 quoted in the literature, and obtained by a variety of techniques. The implications of these findings are discussed.

NA - H[alifax]

PROCEEDINGS

OF THE

Nova Scotian Institute of Science

HALIFAX, NOVA SCOTIA

VOL. XXIII. 1951-1952 PART 2

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Editor: H. Ritchie Chipman
Editorial Board: H. L. Bronson, Dixie Pelluet and J. A. McCarter

Printed for the Institute by the Imperial Press Limited
Date of Publication: February 1954

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PROCEEDINGS
OF THE
Nova Scotian Institute of Science

SESSION OF 1951-52
VOL. XXIII - PART II.

THE WHITE VEINED DAGGER, *Simyra henrici* Grt. (LEPIDOPTERA : PHALAENIDAE), AND ITS PARASITES REARED FROM CAT-TAIL, *Typha* spp.

W. W. Judd
Department of Zoology, University of Western Ontario,
London, Ontario

(Received for Publication June 10th, 1952)

ABSTRACT

Fourteen larvae of *Simyra henrici* were collected from cat-tail leaves in London, Ontario, on September 8, 1951. Eight of the larvae were parasitized, the species of parasites represented being *Rogas stigmator* (Say) (Braconidae), 42.5% males, *Microplitis quadridentatus* (Prov.) (Braconidae) and *Eutritochaeta* sp. (Tachinidae).

The occurrence of the larva of *Simyra henrici* Grt. (*Arsilonche albovenosa* Goeze) feeding on cat-tail, *Typha* spp., has been recorded by Claassen (1921), Cole (1931) and Comstock and Dammers (1935). On September 8, 1951 fourteen larvae of this species were found on leaves of cat-tail, *Typha latifolio* L. and *T. augustifolia* L. in a small swamp at the south-east corner of Adelaide and Cheapside Streets in London, Ontario. Some of the larvae were dead and were fastened to the leaves while others were living and were taken from near the outer ends of the leaves where they had chewed off the tips or had frayed the edges. This habit of feeding at the tips of the leaves is referred to by Claassen (1921). Each larva was placed in a cotton-plugged jar and the living larvae were fed on sections of cat-tail leaves. During ensuing months moths and parasites emerged from the larvae or from cocoons. The moths were identified as *Simyra henrici* Grt. by E. G. Munroe, Systematic Entomology, Department of Agriculture, Ottawa. The three parasites represented were *Rogas stigmator* (Say) (Braconidae), identified by C. F. W. Muesebeck, Insect Identification Division, U. S. Department of Agriculture, *Microplitis quadridentatus* (Prov.) (Braconidae), identified by W. R. M. Mason, Systematic Entomology, Department of Agriculture, Ottawa and *Eutritochaeta* sp. near *noctuiformis* Smith (Tachinidae), identified by J. F. McAlpine, Systematic Entomology, Department of Agriculture, Ottawa.

Simyra henrici Grt.

Five larvae pupated by September 23 in cocoons spun between the sides of the jars and the cotton plugs. Adults of *S. henrici* emerged from these cocoons on February 18, 28, 29, March 6, and 12, 1952. The pinned specimens are deposited in the collections of the University of Western Ontario.

Rogas stigmator (Say)

Seven dead larvae of *S. henrici* were found resting on light webs of silk on the cat-tail leaves. A larva was attached to a web of several narrow pedicels consisting of hardened, amber-coloured, gummy material projecting from the lower surface of the abdomen of the larva and splayed out at their outer ends of the silken web. The integument of these larvae was dried and distended and in one larva it showed fifty emergence holes, 1 mm. in diameter, perforating the dorsal surface of the thorax and abdomen, while in the other six larvae it was intact. From these six larvae adult wasps, *Rogas stigmator*, emerged through circular holes 1 mm. in diameter in the thorax and abdomen during the period September 13-19. The numbers of male and female wasps that emerged are noted in Table 1, there being fifty-one (42.5%) male wasps and sixty-nine (57.5%) females. Two females are deposited in the U. S. National Museum, the remaining specimens being in the collections of the University of Western Ontario.

Clausen (1940) says that wasps of the subfamily Rhogadinae are limited in their host preferences mainly to larvae of Lepidoptera, upon which they develop internally. In discussing the habits of the larvae he records that "just prior to the formation of the cocoon, the mature larva breaks the host skin ventrally and pushes out that portion of the body contents which has not been consumed, and this material dries and fastens the host remains securely to the substratum." This was probably the origin of the narrow pedicels which fastened the dead larvae of *S. henrici* to the silken webs on the cat-tail leaves. Muesebeck et al. (1951) report *Rogas stigmator* as being reared from *S. henrici* and Cole (1931) reared twenty wasps from one larva. Claasen (1921) reared six wasps from one larva, naming them with the synonym, *Aleides intermedius* Cress.

Microplitis quadridentatus (Prov.)

On September 13 one feeding larva of *S. henrici* has become shrivelled and quiescent on the cotton plug and a tough, brown cocoon about 5 mm. long was lodged between the posterior end of the abdomen and the cotton. On March 4, 1952 a female of *Microplitis quadridentatus* emerged from the cocoon. The specimen is deposited in the Canadian National Collection, Ottawa. Clausen (1940) says of the Microgasterinae that they are limited in their host preferences mainly to lepidopterous larvae and he reports of one species of *Microplitis* that the cocoon is formed beneath the caudal portion of the host body. Muesebeck (1922) and Muesebeck et al. (1951) record that *Arsilonche* (*Simyra*) *albovenosa* is a host of *M. quadridentatus.*

Eutritochaeta sp.

On September 13 one larva of *S. henrici* spun a cocoon between the cotton plug and the edge of the jar and on February 2, 1952 an adult tachinid fly emerged. The cocoon was opened and was found to contain the shrivelled larval skin of the caterpillar and the empty puparium of the fly. The fly, determined as *Eutritochaeta* sp. near *noctuiformis* Smith by Mr. McAlpine, is deposited in the Canadian National Collection, Ottawa.

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TABLE I

Numbers of male and female *Rogas stigmator* reared from larvae of *Simyra henrici*.

Date	Larva 1		Larva 2		Larva 3		Larva 4		Larva 5		Larva 6		Total Emergents
September	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	
13			4										4
14			2	4									6
15				3	14	4							21
16					3	11	1		17	1			33
17						1	1	1	1	5		3	12
18	7	2					1	16				12	38
19		6											6
Totals	7	8	6	7	17	16	3	17	18	6	–	15	120

THE ECOLOGY OF SABLE ISLAND, 1952

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Abstract

(Received for Publication February 25th, 1953)

This article describes Sable Island in 1952 with special attention to the flora. Lists of plants collected there are given and are compared to previous records of native and introduced vascular plants, of mosses and of lichens, Birds observed are listed. Attention is given to erosion by wind and by sea, and the conclusion is reached that the gradual attrition of sand-grains, rather than direct wind and wave erosion, is the principal factor in reducing the size of the island. The theory is advanced that the island is, in its present emergence, of late post-Pleistocene age.

SOURCES

The only legitimate source of material for another paper on Sable Island should be first-hand observations, but the past reports deserve reference for comparison with newer records. The Rev. George Patterson collected a great deal of historical, factual and traditional material with regard to the island and published it in 1894 in the Transactions of the Royal Society of Canada. Dr. John Macoun was sent to botanize the island in 1899; his observations were published in the reports of the Geological Survey for that year and his amended lists of plants in his ''Catalogue of Canadian Plants.'' Dr. Harold St. John spent a month on the island in 1913, making a thorough study of the vascular flora, and his results including a very well summarized version of Patterson's and other material, appeared in 1921 in the Transactions of the Boston Society of Natural History. Finally we have a few charts and some pages of discussion of the geology of the island in J. W. Goldthwait's book, ''Physiography of Nova Scotia.''

SABLE ISLAND TODAY

Sable Island is the emergent part of a great sand-bar about one hundred miles southeast of Canso. At high tide the island is about twenty miles long and up to threequarters of a mile wide. The island runs nearly east and west in a shallow crescent, concave to the north, and consists of two lines of dunes, those on the north being much the higher, and a low undulating central valley with ponds of fresh or brackish water and one great salt lake, Wallace Lake or "the lagoon." The freshwater which fills the ponds is rainwater which has soaked into the sand and, being of less density than sea-water, rides on top of the salt water which permeates the island at sea-level. Wallace Lake is said to be now about eight miles long, only a fraction of its former great size, and the sea enters the lake readily at the south side where the dune is reduced to a few hummocks. In the eastern end the dunes are higher, newer-looking and more waterless.

The Old Main Station of maps and botanical records lies near the western end where the sea has cut across the single dune. Some houses, the flag-station and the barn remain, but the lifeboat-sheds and the rollways have been undermined and collapsed by the encroachment of the sea. The present Main Station has been established around the wireless station two miles to the east and consists of a few frame houses and several black Quonset huts. Some of these house the staff and others are storehouses for the year's supplies which are landed by surfboat from the supply-ship in August. Two miles farther east is the meteorological station, a single modern residence with a few surrounding sheds. Then, about three miles from the extreme eastern end, is the "East Light", a wooden lighthouse and, in the shelter of a dune, the small frame house of the lighthouse-keeper. Even more conspicuous at this point is the towering hull of a freighter wrecked on the far side of the island some years ago.

At low tide the island is said to be about forty-five miles long. This I report from hearsay, for, during most of my short visit, visibility varied from twenty yards to one mile. On the northern side low tide exposes merely a few yards more of fairly steep beach and brings the outer bars near to the surface, but on the southern shore the sand-flats seem to extend for miles, although the sound of distant breakers confirms the surveyors' statement that here, too, is a triple line of bars.

Sable Island was long famous for its wrecks and for a number of reasons. For one, the island was low and difficult to see even in clear weather, while its sandspits were dangerous for many miles east and west. Also it was along the line of meeting of the Labrador Current and the Gulf Stream which swirled around the island in a gigantic eddy, the speed of which was sufficient to throw navigators miles out of their reckonings. These currents, one warm, one cold, produced frequent fogs, and, as the island was almost on the outer edge of the continental shelf, it was exposed to the full fury of Atlantic gales. Because of all these dangers life-saving stations have been kept on the island continuously for a century and a half. Today, however, radar, wireless direction-finding and storm-warnings have reduced the losses almost to zero, and the life-saving installations may be due for reorganization.

Variations of temperature are rather less than on the mainland. St. John records a maximum of 77° and a minimum of 5° F. for the years 1898-1901 inclusive, and recently neither of these extremes has been exceeded. Rainfall is much as on the mainland, but the wind is excessive, averaging eighteen miles per hour throughout the year. Even on very calm days one sees patches of brilliance and shadow scurrying up the wind-tunnels among the dunes, little whirlpools of sand in motion, and, when the great gales blow, this sand has the force of birdshot. Bottles that have lain about for a year are frosted on the surface by the friction, and great hills are undermined and shifted in a few hours. The tattered vegetation is subjected in winter to burying, sand-blasting and a frequent salt spray from the sea.

VEGETATION

The terrain of the island may be divided into about six categories, each with its own flora. The sea-beaches, particularly the northern one, are remarkably soft, and the surf in rough weather runs up to the very foot of the sand-bluffs, churning up the beach so that plants find no footing. Here and there, however, in the mouths of wind-channels in the dunes, a few salt-loving plants find foothold. *Cakile edentula* is common, *Atriplex patula hastata* is commoner on the south beach. St. John recorded that in 1913 *Arenaria peploides robusta* was in great clumps much visited by the ponies, but today only small fragments remain. *Senecio Pseudo-Arnica* was found in this habitat by all previous collectors, but I failed to find it.

Next inland come the high dunes. These are continually being eroded on the sea-side and built up on the landward side by sand blown up from the beach. Small plants cannot stand such burying or the dryness of the site, so that the flora consists chiefly of marram-grass, *Ammophila breviligulata*, beach-pea, *Lathyrus japonicus*, yarrow, *Achillea lanulosa*, and seaside goldenrod, *Solidago sempervirens*, the last two growing to unusually great size. On the high narrow dune that separates the west end of Wallace Lake from the north shore, there is often a thin covering of *Poa subcaerulea*, a native blue-grass. In this area the beach-pea is thick and luxuriant in agreement with St. John's description of the whole island in 1913, whereas in the rest of the island the growth seems feeble, probably becaise the peas are overgrazed in spring in the neighbourhood of the freshwater ponds. This high dune is grazed in winter, at least, as is shown by the droppings of the ponies, which consist of compacted fibres of sand-grass roots.

The middle of the island receives less and finer sand. The low dunes are covered with much vegetation a few inches in height. Beach-grass is consistently overgrazed; tall plants of *Spartina pectinata* are untouched by the ponies, common juniper makes thick mats, *Juniperus horivontalis* droops like a blue valance over the edge of raw bluffs dug out by the wind. *Rosa virginiana*, *Rubus arcuans*, *Viburnum cassinoides* and

Myrica pensylvanica are the tallest shrubs On the open dunes are evening primroses, *Oenothera parviflora* and *O. cruciata sabulonesis.* Near the houses and ponds there is an abundance of centaury, *Centaurium umbellatum,* a pink-flowered gentian common on sandy soils in Europe but hardly known in North America. Both St. John and Macoun found no difficulty in distinguishing native from introduced plants and both considered this plant to be native. I find the greatest difficulty in making up my mind about several plants of the island, but I should have no doubt that this gentian was introduced, probably in the ballast of wrecked ships. It spreads readily in the sand and is not eaten by the ponies, an important factor in survival. *Centunculus minimus,* chaffweed, a cosmopolitan sand-plant, was found only once by me, although earlier collectors considered it to be abundant. This plant is known also from Prince Edward Island.

Near the ponds cranberries, *Vaccinium macrocarpon,* make a thin lace over the sand, and *Eleocharis parvula* and *Myriophyllum tenellum* grow into a turf grazed by the ponies. *Limosella subulata* reaches three inches in height, and *Tillaea aquatica* grows both as compa tufts and as erect reddish plants with pedicelled lower flowers.

Brackish ponds have waterweeds, *Potamogeton bupleuroides* and *P. oblongus* and *Ruppia maritima.* On the salt flats *Ranunculus Cymbalaria* creeps in wide rosettes, while greater plantain and *Chenopodium rubrum* are thinly scattered. Wallace Lake is said by St. John to be full of eel-grass, *zostera marina,* and to have a lush beach growth on the inner shore. I had time to follow only the western side of the lake and I saw no trace of eel-grass, either growing or as wrack, though I had come in search of it. The shores seemed to be bare of life, and the lake was silting up rapidly. Perhaps St. John was referring to the western section of the lake which has now silted up completely, but which was still four miles long in the 1899 survey.

The last category includes the neighbourhood of buildings where there is the usual shifting population of weeds, grasses and clovers.

PREVIOUS COLLECTORS

Our knowledge of the botany of Sable Island is still incomplete. The first serious records were made by Jonathan Dwight, Jr., who visited the island in 1895 to observe the nesting of the Ipswich sparrow. Then Macoun, in 1899, gave us our most complete lists of vascular plants and cryptogams. Mr. H. P. Glazebrook, master of one of the life-saving stations, collected a few plants, and in 1911 Dr. H. T. Gussow visited the island and listed plants observed. In 1913 Dr. Harold St. John, inspired by Fernald's coastal-plain hypothesis, spent four weeks on the island and collected vascular plants with great care. To this visit we owe the naming of many endemic varieties and species peculiar to Sable Island and otherwise known only from similarly isolated areas of poor sandy soil. For my part I should have entirely overlooked these differences, except in the case of *Juncus pelocarpus sabulonensis.* In variable species ten generations of inbreeding will produce a variety recognizably different from the average of the ancestral stock, and a single cross back to that stock will re-establish the older type. The fact that in two cases St. John found two varieties, one normal and one new, of the same species in the island, were the number of individual plants is so limited, would cast suspicion upon the importance of such differences.

In my list of the vascular native plants of the island I have shown the name as it appears in St. John's list. St. John had checked Macoun's specimens and had modernized the names, while I have not seen St. John's. I have added the names now used in the 1950 Gray's Manual and have queried some identities. I have included also a number of his varieties which, I think, might as well be lumped with the species.

Macoun and St. John found a number of plants that I missed, and the source of most of these is given by St. John. as the eastern end of Wallace Lake, an area which I could not reach in the time. Some that St. John found and that Macoun and I missed are, like Bartonia, not recognizable until late in August. Macoun and I found four that St. John missed: *Danthonia spicata*, *Habenaria viridis bracteata*, *Menyanthes trifoliata minor*, and *Drosera intermedia.* The first two are plants of early summer and were barely recognizable when I found them, although the summer that year was very late; St. John, collecting even later in a normal season, might well have missed them. The last two are plants of wet places, and I found them on pond-bottoms exposed after an almost rainless July. If St. John was collecting after a wetter July, they might have been submerged at his passing. Such accidental differences in the lists, and the fact that a lifeboat master could find in June a violet missed by four experienced collectors in August, suggests that our knowledge is probably still incomplete.

My own additions to the native vascular flora are small. I found one patch of *Triglochin palustris* which is never very common nor easy to see. Near the cookhouse, in a swampy sump, I found a plant which has the key-characters of *Scirpus maritimus Fernaldii.* I have included it doubtfully, for I have yet to be convinced that the species, as we know it here, is more than an environmental form of *S. paludosus.* *Poa subcaerulea* is new to the list but was probably included in *Poa pratensis* which St. John classed as a native species. It should be borne in mind, however, that natural introductions of new species are probably still going on, so that the finding of a new plant may not mean that previous collectors missed it.

I have kept separate a list of introduced vascular plants, because I had not at first intended to collect these, owing to lack of space in my presses. Gussow's list is similarly incomplete in this field, while St. John had not only much leisure in which to pick over the weeds of garden and midden but also the great afforestation scheme of 1901 to elegize. Very few introduced plants have spread widely. *Rumex Acetosella* is everywhere, but I consider this doubtfully an introduction. *Agropyron repens pilosum* and *Plantago minor* have spread along the southern beach, but St. John considers them native and I do not. Of the afforestation I found only one fifteen-inch shrub of buckthorn, *Rhamnus Frangula*, of which I collected half, quite unconscious of the fact that it must have cost ten thousand dollars to establish this plant.

My third list is of mosses and my fourth of lichens. I have found no previous records of these except in Macoun's Catalogue. No fungi were observed and only floating fragments of seaweeds. Lichens were fairly frequent but of few species. *Cladonia rangiferina* and *C. uncialis* grew in thin patches; *Cetraria aculeata* was occasional as on most mainland sandhills; *Parmelia physodes* frilled the six-inch stems of shrubs or crept over the sand. Mosses, too, were infrequent, and, after the dry July, none were in fruit or with gemmae. *Sphagnum subsecundum* grew in small white patches on wet sand, growing upward as it was buried, and harbouring *Aulacomnium palustre*. *Sphagnum papillosum* grew in more robust but rarer patches. *Drepanocladus aduncus*, a form with plicate leaves, grew among the rushes at the edge of ponds, and this may be the same species as Macound's *D. fluitans*. *Leucoryum glacum* and sterile *Pphlia* and *Bryum* grew along the edges of low bluffs near the ponds.

FAUNA

I had too little time and no equipment to investigate the fauna. Patterson has a list of molluscs found on the island, but I know nothing of this group and, perhaps that reason, observed none. I noticed a freshwater sponge abundant in the ponds, and I suppose this to be *Heteromeyenia Macunii*, an endemic species said by MacKay to have affinities with New

England sponges. Insects were not observed, but insect-eating birds were present.

Birds observed were: Double-crested Cormorant, at sea; Black Duck, abundant in ponds; Semipalmated, or perhaps Piping, Plover, at sea and on beaches; Ruddy Turnstone, on beaches; Spotted Sandpiper, by ponds; Least Sandpiper, on beaches and by ponds; Sanderling, not certainly identified, on beach; Greater Shearwater, at sea, hunting with porpoises; Black-backed Gull, common; Herring Gull, commoner; Common Tern, very common; Barn Swallow, around buildings; Yellow Warbler, seen in distance and rather uncertainly confirmed by residents; Wilson's Snipe, rare; Ipswich Sparrow, abundant everywhere. One crow is said to live on the island, and Macoun saw "Canadian nuthatches", and the history of the island mentions snowy owls. The Ipswich sparrows were tame and easily watched. They are large grey Savannah sparrows which breed, as far as is known, only on Sable Island. I heard none singing, although at that time the Savannahs of the mainland were still in good song, and the residents say that the "greybirds" do not sing at any season. Some remain all winter.

It is said that foxes, red and black, were native to the island in early days and were later exterminated. Rats from wrecked ships are said to be common, but I saw no trace of them. There is said to be one rabbit, probably a tame one and not descended from any of the frequent introductions. Seals used to haunt the beaches in thousands, but I saw only two harbour-seals which lifted themselves shoulder-high out of the breakers to watch the men unloading the surfboats. Porpoises were once seen at sea, and many were found stranded on the south beach.

The ponies are a most attractive feature of the island. Their origin is lost in the hearsay of island history. Horses and cattle were introduced by the Portuguese in the sixteenth century and became abundant, but both are said to have been killed out in the eighteenth century. In 1738 LeMercier is said to have stocked the island with cattle, and it is presumed that he brought horses from New England at the same time. Certainly they are mentioned frequently thereafter, for the island was never again uninhabited for long periods. Today ponies are almost always in sight, grazing in family groups called "gangs" which consist of a stallion, two or three mares and some young ones. They seemed in excellent condition, but the mares were rearing, by my estimate, a foal to every three and one-third years, not a high birth-rate. There were no old or sickly animals about, and frequent skeletons left over from the winter explained why. I kept a rough count of those seen and estimated that I had observed one hundred and forty in two-thirds of the island, which would give a total of about two hundred for the whole. Ponies were much more abundant in the east end, which suggests that an averaging estimate may be very inaccurate. These ponies are, of course, descended from horses of normal domestic size and have in forty generations reverted almost to the size of their wild ancestors.

PHYSICAL HISTORY

Geologists have not agreed upon the origin of Sable Island. Goldthwait suggests the analogy of the double sandbars that link pairs of the Magdalen Islands but admits that there are no known planed-off islands to initiate such a formation. Others have suggested that the sand has been swept together by the fairly rapid currents which eddy around this spot. A third possibility would have been a great drumlin or moraine now sifted into sand and not yet scattered.

The first description of the island is from French sources of 1633 and describes it as being forty miles in "circumference" and much longer than wide. This would be true today. A student of the island, S. D. Macdonald, was indignant at this and estimated that, if erosion had been constant, the island at that date must have been two hundred miles long and eight hundred feet high. The figures on which he based his theory have been gathered by Patterson. They report the destruction from the west end of: four miles, 1814; four miles, 1820; eleven miles in the thirty years before 1851, according to Joseph Howe; three miles, 1881-3; and I was told of another three miles lost in the nineteen-thirties. Of the original nine miles west of Wallace Lake thirty-three have been washed away and six are left. These are typical Sable Island statistics.

The charts tell a different story, although their gloss is often as confusing. Two surveys, made independently in 1766 and in 1770, show the island to have measured twenty-four miles in a straight line from tip to tip. I have not found a copy of the chart of 1828. In 1850 Capt. Bayfield, a famous maker of maps, surveyed the island and found that it had lost two miles from the west end and had gained nothing on the east end since 1828. Another author says that this survey shows that the island had lost six miles from the west end and had gained five miles on the east. The chart shows the island then to have been twenty-three miles from tip to tip. In 1899 the Geological Survey again mapped the island, and their chart shows it to have been twenty-four miles from tip to tip. I have seen no more recent survey. What is obvious from the charts as well as from descriptions is that the island has narrowed progressively throughout this period. Today few places can be more than half a mile wide.

On going ashore on Sable Island I was struck immediately by the extreme looseness of the sand. On the dunes, and even on the damp beach, one sank almost ankle-deep. I noticed that the waves came up the beach but did not run back again; instead, they sank into the sand. It occurred to me that this would be reasonable if the sand-grains were rounded. I did not think to collect sand from the beach, but I had plenty on the roots of my plants, and I have drawn and measured samples and compared them to three other lots of quartz sand. The samples were collected by passing a slide of unsorted sand under the microscope and measuring and drawing each grain as it appeared in the field. Measurements are in microns. The rotundity quotient is the result of dividing the longest diameter of each grain by the shortest diameter, each line to pass through approximately the centre of the grain. Measurements are based on the average of ten grains of which only the first five are pictured.

Origin of Sand.	Maximum	Minimum	Average	Rotundity
Lake Mockingigh, Hants County	667	238	442	58
Sand Lake, Outram, Annapolis County	2125	119	539	.56
Cape North Corner, Victoria County	646	204	423	.48
Sable Island	1105	425	624	.80

Only the roundness and the minimum measurements of the Sable Island grains seem to be significant. This roundness of the grains must affect the building up of the island. A sphere presents the maximum average cross-section to forces from all directions, and has the minimum average surface touching other surfaces, and has the smallest area of surface for its volume. Waves passing over sands will lift such spherical particles most readily and will also drop them most readily. Waves of water will be accompanied by slower waves of sand, the bars, which will move towards the shore and break at last upon the beach. Winds from north or south will be pressed upwards by the coastal dunes and, increasing in volocity, will funnel the beach-sand upward. On passing the dunes they will lose speed and will drop it again. So the dunes will move slowly inland. The smallest sand-particles will be carried farthest and will be most often lost. Larger particles which fall soon into the sea, will be brought back again by the waves until in time they are worn down into smaller ones and so lost. Thus the total bulk of the island diminishes.

Patterson pointed out that periods of erosion alternated with periods of stability, and he attributed the erosion of the island chiefly to the wind which carried away hundred-foot sandhills in a single gale. Macoun disagreed with this and considered the wind to be the builder and the sea the destroyer. I consider the sea and the wind to be both builders and both destroyers, the sea being the more powerful in each category.

Macoun also thought that Sable Island had never had trees and was incapable of harbouring them. However, the government carried out a huge experimental afforestation of the island in 1901. Dr. Saunders visited the coasts of Brittany to get information about the trees hardiest on the coastal sands, the soils of Sable Island were analyzed and fertilizers were sent out, everything was done to make the project a success, except small-scale experiment. Then more than eighty thousand trees and shurbs were planted out and thirty pounds of pine-seed was scattered. By 1913 the plantings were reduced to seventy-seven survivors; in 1937, according to a lifeboat man, one pine-tree, growing flat to the ground, was still to be seen; and in 1952 there remained only one small shrub of buckthorn. Güssow and St. John found heather, introduced accidentally then, and it is possible that the holly-shrubs now scattered over the west end of the island may have come in with the trees, for Macoun did not see them.

Today anti-erosion schemes are again afoot, and it is possible that the extensive use of *Rosa rugosa* and tamarisks might reduce the shifting of the inland sands and speed the building up of dunes. A reduction of the number of ponies to the point where the sand-grasses again found it possible to seed, might help to bind the high dunes on the inner side. But such measures should be justified only by their effect upon the amenities of the island. They will not lengthen its life by one percent.

My own view of the island does not include any possibility that this huge sandbank has any long future before it or any long past behind it. Almost certainly it is built of sand ground from rocks of the neighbouring shore. Any such material exposed on the continental shelf must have, in the course of centuries, been reduced to sand. During the glacial period when millions of cubic miles of water were locked up on the land in the form of ice, the sea-level was reduced progressively by about three hundred feet, and, during this long period, perhaps twenty thousand years, no island such as Sable could have failed to be cut down to below the level of the waves. However, if this sand could again have been collected on the shelf, whether by the Labrador Current or other means, when the sea-level was lowered again by some fifty feet during the twelfth century, the top of this bank would again have emerged sufficiently to be acted upon by the waves.

A flat table of sand at about the five fathom depth would, of necessity, have given rise to an island of sand. If it were high enough to slow down the waves, the waves would carry more sand inward than outward as on a beach. Bars would roll inward and build up to tide-level. Then a beach would emerge and be drifted into ripples, waves, dunes, by the action of the wind. So the island would emerge like an atoll of sand, highest at the outer edge parallel to the edge of the submerged sandbank, holding in its centre a lake, at first of the original depth of the surface of the sandbank but slowly filling up. The prevailing westerly winds would tend to drift the island eastward, but the average force of the waves would be least strong from the west, in which direction they have the shortest run, so that the sea would tend to push it back again. The inward movement of the dunes of Sable Island, unmistakable on the charts, is a measure of the gradual attrition of the mass of sand upon which it rests. If the present island were to be erased in a night of storm, a few years of waves and wind would rebuild it in much its present form, for the emergent island must be less than one percent of the submerged bank. But, when the bank is worn down, the island must go with it, and all the sand-binding plants in the world will not stop it. We may expect in the next two centuries to see the dunes squeezing together until they meet and then are cut down to a fifty-mile bar below the level of the tide.

St. John's visit to Sable Island was inspired by Fernald's "coastal-plain hypothesis" which tried to explain an interrupted distribution of beach-plants from Maryland to Nefoundland. If the present fishing-banks had emerged above the water, they would have provided the desired stepping-stones of unglaciated land along the coast. This theory was at first welcomed by New England geologists who needed some such row of islands during the glacial period to explain why their coast had been then so little eroded. However, other geologists have insisted that the banks are too deep to have emerged, and Fernald himself was later obliged to push his coastal-plain back in time to the beginning of the Tertiary period when it was, in the author's opinion, not needed. If, however, our theory of the origin of Sable Island is correct, and such an island can result from a comparatively small lowering of sea-level, we should have expected many such islands to have emerged during the progressive lowering of the sea during the ice-age. Each of these would have been built up and cut down again during its brief thousand years, only to emerge again with the next lowering of the sea. Yet during their short lives they may have offered temporary footing for many sand-plants which the ice killed out on the neighbouring shore, while the present level of the banks, a few fathoms below the lowest level of the recent sea, is the state in which we expect Sable Island to remain in another thousand years.

St. John found confirmation for Fernald's theory, as he held it in that time, in the presence of southern species, such as *Centaurium* and *Centunculus* and Macoun's sponge, as well as of northern species, *Tillaea*, *Epilobium nesophilum*, *Potamogeton oblongus* and *Juncus bulbosus*, whidh were not known on the Nova Scotian mainland. Since that time, however, *Tillaea* has been found in Shelburne and Cape Bretoh counties, *Pota-*

mogeton oblongus twice in Inverness County, and *Centunculus* in Prince Edward Island. *Centaurium* is probably introduced. There remains two northern plants not known from nearer than Newfoundland, and an endemic sponge of southern affinities, to support the theory of the antiquity of the island. Theories have been built on less. On the other hand, my suggestion that the island may have emerged as recently as 1100 A.D. must be viewed rather as an antithesis to the older thesis than as a serious hypothesis. We can only reach a sound dating when geologists can give us a clear table of the relative movements of land and sea in this area during the post-Pleistocene period.

SUMMARY

The flora of Sable Island remains much as in previous reports. A few new species have been added to the lists for the island, but many, chiefly woodland species, were not observed, while the abandonment of all farming has reduced the variety of weeds. The pony-population is only half what earlier records claimed, yet the grass seems badly overgrazed. The author saw no evidence of antiquity in the plants named as endemics by Fernald and St. John and considers them rather to be inbred and depauperate mainland species. Geologically the island can scarcely be older than the peak of the Wisconsin glaciation, about 6000 B.C., and may be as recent as the last confirmed lowering of sea-level associated with the regrowth of northern glaciers in the twelfth century A.D.

ACKNOWLEDGEMENTS

Grateful acknowledgement must be expressed to the Nova Scotia Museum of Science for financing this trip to Sable Island in the interest of building up the herbarium, to the Ministry of Transport for transportation and permission to land, and to Acadia University and Mr. W. B. Schofield for the loan of books. Dr. A. L. Andrews of Ithaca, N. Y., was kind enough to determine one dubious moss and Dr. H. L. Blomquist of Duke University to name the two sphagna.

ADDENDUM

A visit to the island in 1953, from 28th to 30th August, yielded some additional observations.

Geological; The previous winter had had unusual storms which had driven saltwater far into the brackish ponds, resulting in the death of much vegetation. However, the storms had also driven up on the beach at the eastern end of the island large quantities of pebbles which were not noticeable the year before. These were of quartz, quartzite, granite, felsite and less definitely classifiable igneous rocks. They were somewhat water-rounded, but the larger ones usually showed a flattened "sole" suggesting glacial origin. Professor Cameron of Acadia University was of the opinion that these stones had been through the glacial mill and were of varieties to be expected in local glacial deposits. Of course, one cannot eliminate the possibility that wrecked ships may have been ballasted with similar material from the mainland, but, if so, many such ships must have been wrecked along some ten miles of coast and all of them ballasted with the same assortment of rocks. With this reservation, the origin of the island as a glacial moraine is supported, since no ocean current could have swept together such pebbles.

Botanical: A few weeds but no new native vascular plants were added to the lists for the island, but some additions to the author's list were made by Mrs. Cameron of the Meteorological Station and by the author.

Schools of small fish were observed in the ponds, and some *additional birds were*: Pied-billed Grebe; Leach's Petrel; Heron; Bluewinged Teal (with young); Blackbellied Plover; Golden Plover, Dowitcher; Knot; Solitary Sandpiper; White rumped Sandpiper; Semipalmated Sandpiper; Greater Yellowlegs; Lesser Yellowlegs; Upland Plover (new to the author and so not reliable); Sanderling; Bonaparte's Gull; Blackbilled Cuckoo; Nighthawk; Bank Swallow; Crow (flock of nine); Mockingbird!; Cedar Waxwing.

SABLE ISLAND VASCULAR PLANTS—NATIVE

(In order to link this list with St. John's, his name is given first and, when this has been changed, it is bracketed and the Gray's Manual, 1950, name added. For brevity, references are omitted.) Legend: J.M. = Macoun; HG = Gussow; SJ = St. John; JSE = Erskine. x = collected; = not collected.

	JM	HG	SJ	JSE	Others
Polypodium virginianum L.	x	–	–	–	–
Osmunda cinnamomea L.	x	x	x	–	–
Lycopodium inundatum L.	x	x	x	–	
Juniperus communis **megistocarpa** Fern. & SJ	x	x	x	x	
Juniperus horizontalis Moench.	x	–	x	x	
Typha latifolia L.	x	–	x	–	
Sparganium angustifolium Mx.	x	–	x	x	
(*Potamogeton polygonifolium*)	x	–	x	x	
= *P. oblongus* Viviani					
Potamogeton epihydrus Raf.	x	–	x	–	
(*Potamogeton bupleuroides* Fern.)	x	x	x	x	
= *P. praelongus* L., *bupleuroides*					
P. pusillus (*capitatus*) L.	x	–	x	–	
Ruppia maritima f. *longipes* Hagstr.	x	–	x	x	
Zostera marina L.	x	x	x	–	
(*Panicum huachucae* Ashe)	x	–	x	x	
= *P. languinosum fasciculatum* (Torr.)					
Fern. *Agrostis alba* (*maritima*)	x	x	x	x	
A. (*hyemalis*) *geminata* Trin.	–	–	x	–	
Ammophila breviligulata Fern.	x	x	x	x	
Deschampsia flexuosa (L.) Trin.	x	x	x	–	
Danthonia spicata (L.) Beauv.	x	–	–	x	
(*Spartina Michauxiana* Hitchc.)	x	x	x	x	
= *S. pectinata* Bosc					
Poa pratensis L. (if *P. subcaerulea* Sm. was intended)	x	x	x	x	
Glyceria Fernaldii (Hitchc.) St. John	x	–	–	–	
Festuca rubra L.	x	x	x	–	
F. rubra glaucescens (Hartm.) Holm.	–	–	x	x	
Agropyron repens (var.) = f. *pilosum*	–	–	x	x	
Elymus arenarius villosus Mey.	–	–	x	x	
Eleocharis palustris (L.) R. &. S.	x	x	x	–	
E. palustris glaucescens	x	–	x	–	

	JM	HG	SJ	JSE	Others
E. halophila Fern. (probably both of above)	–	–	–	x	
(*Scirpus nanas* Spreng.)	x	x	x	x	
=*Eleocharis parvula* (R. & S.) Link.					
S. americanus Pers.	x	x	x	x	
(*S. acutus Muhl.*)	x	x	x	x	
=*S. validus Vahl*					
S. (*campestris* var.) *paludosus*	x	–	x	x	
S. maritimus var. *Fernaldii* (Buckn.) Beetle	–	–	–	x	
Carex hormathodes Fern.	x	–	x	x	
C. silicea Olney	x	–	x	x	
C. echinata Murr.	x	–	x	–	
C. (*echinata* var.) *cephalantha*	x	–	–	–	
C. canescens L. var. *disjuncta* Fern.	x	–	x	x	
C. deflexa Hornem.	x	–	–	–	
(*C. Oederi* var. *pumila*)	x	–	x	x	
=*C. viridula* Mx.					
Triglochin palustris L.	–	–	–	x	
Eriocaulon septangulare With.	x	–	x	x	
Juncus bufonius L.	x	x	x	x	
J. b. var. *halophilus* Buchenau & Fern.	–	–	x	–	
J. tenuis Willd.	x	x	x	x	
J. balticus Willd., var. *littoralis* Engelm.	x	x	x	x	
J. canadensis J. Gay	x	x	x	x	
J. pelocarpus var. *sabulonensis* St. John	x	–	x	x	
J. bulbosus L.	x	–	x	x	
J. articulatus var. *obtusatus* Engelm.	–	x	x	x	
(*Luzula campestris acadiensis*)	–	–	x	–	
=*L. multiflora acadiensis* Fern.					
Smilacina stellata (L.).Desf.	x	x	x	x	
Iris versicolor L.	x	x	x	x	
(*Sisyrinchium gramineum*)	x	–	x	x	
=*S. angustifolium* Mill.					
(*Habernaria bracteata*)	x	–	–	x	
= *H. viridis* (L.) R. Br., var. *bracteata* (Muhl) Gray					
Habenaria clavellata (Mx.) Spreng.	x	x	x	x	
Habenaria lacera (Mx.) R. Br.	x	x	x	x	
Calopogon pulchellus (Sw.) R. Br.	x	x	x	x	
C. p. (forma) *var.* **latifolius** (St. J.) *Fern.*	–	–	x	x	

	JM	HG	SJ	JSE	Others
(probably a late-summer form)					
Spiranthes Romanzofiana Cham.	x	–	–	–	
Myrica carolinensis Mill.	x	x	x	x	
(*Rumex Britannicus* L.)	x	–	x	–	
= *R. orbiculatus* Gray					
Rumex (*maritimus* var.) *fueginus*	x	–	x	x	
Polygonum Raii Bab.	–	–	x	–	
P. hydropiperoides var. psilostachyum St. J.	x	x	x	x	
Chenopodium rubrum L.	x	x	x	x	
Atriplex patula L., var. *hastata* (L.) Gray	x	x	x	x	
(*Spergularia leiosperma* Kindb.)	x	x	x	x	
= *S. marina* (L.) Griseb., var. *leiosperma* (K.) G.					
Sagina procumbens L.	x	–	x	x	
Arenaria lateriflora L.	x	x	x	x	
A. peploides L., var. *robusta* Fern.	x	x	x	x	
(*Nymphozanthus variegatus* (Engelm.) Fern.)	x	–	x	x	
= *Nuphar variegatum* Engelm.					
Ranunculus Cymbalaria Pursh.	x	–	x	x	
R. reptans L.	x	x	x	x	
Thalictrum polugamum Muhl, var. *hebecarpon* F.	x	x	x	x	
Coptis trifolia (L.) Salisb.	x	–	x	–	x
Cakile edentula (Bigel.) Hook.	x	x	x	x	
Drosera rotundifolia L.	x	x	x	x	
(*Drosera longifolia* L.)	x	–	–	x	
= *D. intermedia* Hayne					
Tillaea aquatica L.	x	–	x	x	
(including records of *T. Vaillantii*)					
(*Pyrus atropurpurea*)	x	–	x	x	
= *P. floribunda* Lindl.					
Fragaria virginiana Duch., var. *terrae-novae*	x	x	x	x	
Potentilla norvegica L.	x	x	x	x	
P. palustris (L.) Scop.	x	–	x	x	
P.palustris, var. *parvifolia* (Raf.) Fern.	–	–	x	–	
P. tridentata Ait.	x	x	x	x	
(*P. pacifica* Howell)	x	x	x	x	

	JM	HG	SJ	JSE	Others
=*P. Oederi groendlandica* (Tratt.) Pol-					
Rubus hispidus L.	x	–	–	–	
Rubus **arcuans** *Fern. & St. J.*	x	x	x	x	
Rosa virginiana Mill.	x	x	x	x	
(*Lathyrus maritimus* (L.) Bigel.)	x	x	x	x	
=*L. japonicus* Willd.					
L. palustris L., var. *macranthus* (T.G. W.) F.	x	x	x	?	
(some plants nearer to v. *linearifolius*)					
L. P., var **retusus** *Fern. & St. J.*	–	–	x	?	
(some plants have some such leaves)					
Empetrum nigrum L.	x	x	x	x	
Ilex verticillata (L.) Gray	–	–	x	x	
Hypericum boreale (Britt.) Bickn.	x	x	x	x	
H. virginicum L.	x	x	x	x	
Viola septentrionalis Greene	–	–	–	–	x
V. lanceolata L.	x	x	x	x	
V. primulifolia L.	–	–	x	x	
V. pallens (Banks) Brainerd	–	–	x	x	
V. incognita Brain., var. *Forbesii* Brain.	–	x	–	–	x
(*Epilobium molle sabulonense*)	x	–	x	–	
=*E. nesophilum* Fern., *var.* **sabulonense** F.					
Oenothera cruciata Nutt., *v.* **sabulonensis** *F*	x	–	x	x	
(probably a form of next species)					
(*Oenothera muricata* L.)	x	–	x	x	
= *O. parviflora* L.					
Myriophyllum tenellum Bigel.	x	x	x	x	
Hippuris vulgaris L.	x	x	x	x	
Ligusticum scothicum L.	–	–	x	–	
Coelopleurum lucidum (L.) Fern.	x	x	x	x	
Cornus canadensis L.	–	–	–	–	x
(*Vaccinium pensylvanicum* Lam.)	x	x	x	x	
=*V. angustifolium* Ait.					
Vaccinium macrocarpon Ait.	x	x	x	x	
Lysimachia terrestris (L..(BSP	x	x	x	x	
Trientalis borealis Raf.	x	–	x	x	x
Centunculus minimus L.	x	–	x	x	
(*Bartonia iodandra sabulonensis*)	–	–	x	–	
= *B. paniculata* (Mx.) Muhl., **sabulonensis** Fern.	–	–	x	–	

	JM	HG	SJ	JSE	Others
Menyanthes trifoliata L.	x	–	–	x	
Centaurium umbellatum Gilib.	x	x	x	x	
Convulvulus sepium L.	x	–	x	x	
Teucrium canadense L. (var. *littorale*)	–	–	x	–	
Lycopus uniflorus Mx., (*var.* **ovatus** F & SJ	x	x	x	x	
(variety now suppressed even by Ferald)					
Mentha arvensis L.	–	–	x	–	
Limosella subulata Ives	x	–	x	x	
(*Agalinis paupercula neoscotica*)	x	–	x	x	
= *Gerardia neoscotica* Greene					
(*Euphrasia purpurea* Randii)	x	(x)	x	x	
= *Euphrasia Randii* Robins., v. Far-Robins., forma *iodandra* (F. & W.) Fern.					
Rhinanthus Crista-galli L.	x	x	x	x	
Utricularia cornuta Mx.	x	–	–	–	
Plantago major L., (var. *intermedia*)	x	x	x	x	
(*P. decipiens* Barn.)	x	x	x	x	
= *P. juncoides* Lam., v. *decipiens* (B) Fern.					
Galium trifidum L.	x	x	x	x	
G. Claytoni Mx.	–	–	x	–	
Mitchella repens L.	x	x	x	–	x
(*Lonicera caerulea calvescens*)	x	–	–	–	x
= *L. villosa* (Mx.) R. & S., v. *calvescens*					
Linnaea borealis L., var. *americana*	x	x	x	–	
Viburnum cassinoides L.	x	x	x	x	
Lobelia Dortmanna L.	x	–	x	x	
Solidago sempervirens L.	x	x	x	x	
Aster novi-belgii L.	x	x	x	x	
A. n-b., var. *litoreus* Gray	x	–	x	–	
Anaphalis margaritacea subalpina	x	–	x	x	
Gnaphalium obtusifolium L.	x	x	x	x	
Bidens frondosa L.	x	–	–	–	
B. connata Muhl., var. *petiolata* (Nutt.) Far.	–	x	x	–	
Achillea lanulosa Nutt.	x	x	x	x	
Senecio Pseudo-arnica Less.	x	x	x	–	
Prenanthes trifoliolata (Cass.) Fern.	x	x	x	x	

	JM	HG	SJ	JSE	Others
(*P. nana* (Bigel.) Torr.)	–	–	x	–	
= *P. t.*, var. *nana* (Bigel.) Fern.					
Hieracium scabrum Mx., *var.* **leiocaule** F & SJ	x	x	x	x	

INTRODUCED VASCULAR PLANTS

Pinus montana Mill.	–	–	x	–	
P. sylvestris L.	–	–	x	–	
Picea canadensis (Mill.) BSP	–	–	x	–	
Echinochloa Crusgalli (L.) BSP	–	–	x	–	
Anthoxanthum odoratum L.	–	–	x	–	
Phleum pratense L.	x	–	x	x	
Avena sativa L.	–	–	x	x	
A. S., var. *orientalis* (Schreb.) Richter	–	–	x	–	
Poa annua L.	x	–	–	x	
P. palustris L.	x	–	–	–	
P. pratensis L. (See *P. subcaerulea*)	?	?	?	x	
Bromus secalinus L.	x	–	–	–	
Agropyron repens L.	x	–	x	x	
Hordeum jubatum L.	x	–	x	–	
Betula pendula Roth.	–	–	x	–	
B., alba L.	–	–	x	–	
Rumex crispus L.	x	–	x	–	
R. Acetosella L.	x	x	x	x	
Polygonum aviculare L.	x	–	x	–	
P. l., var. *prostratum Wimmer*	–	–	x	x	
Chenopodium album L.	x	–	x	x	
C. Bushianum Aellen	–	–	?	x	
Spergula arvensis L.	x	–	x	–	
Stellaria graminea L.	x	–	x	x	
S. media (L.) Cyrill.	x	–	x	x	
Cerastium vulgatum L.	x	–	x	x	x
Silene noctiflora L.	–	–	x	–	
Ranunculus repens L.	x	–	–	–	
R. acris L.	x	–	x	x	
Portulaca oleracea L.	–	–	?	–	
Capsella Bursa-pastoris (L.) Medic.	x	–	x	–	
Raphanus sativus L.	–	–	x	–	
R. raphanistrum L.	–	–	–	x	
Brassica arvensis (L.) Ktze.	x	–	x	x	
Sisymbrium officinale (L.) Scop.	–	–	x	–	

	JM	HG	SJ	JSE	Others
Hydrangea paniculata grandiflora Sieb.	–	–	x	–	
Rosa rugosa L.	–	–	–	x	
Cytisus scoparius (L.) Link.	–	–	x	–	
Trifolium pratense L.	–	x	x	x	
T. repens L.	x	–	x	x	
T. hydridum L.	x	–	x	–	
Vicia Cracca L.	–	–	–	x	
Acer plantanoides L.	–	–	x	–	
Rhamnus Frangula L.	–	–	x	x	
Pastinaca sativa L.	–	–	x	–	
Daucus Carota L.	–	–	x	–	
Calluna vulgaris (L.) Hull.	–	x	x	–	
Lappula echinata Gilib.	–	–	x	–	
Galeopsis tetrahit L., v. *bifida* (Boehm.) L & C	–	–	x	–	
Solanum nigrum L.	x	x	x	x	
Lycium europaeum L.	–	–	x	–	
Gnaphalium uliginosum L.	x	–	x	–	
Rudbeckia hirta L.	x	–	–	–	
Anthemis Cotula L.	x	x	x	–	
Matricaria matricarioides (Less.) Port.	–	–	–	x	
Chrysanthemum leucanthemum pinnatifidum	–	–	x	x	
Cirsium arvense (L.) Scop.	x	x	x	–	
Cichorium Intybus L.	–	–	x	–	
Leontondon autumnalis L.	x	x	x	x	
Taraxacum officinale Weber	x	–	x	x	
Sonchus asper (L.) Hill	–	–	x	x	
Sonchus arvensis glabrescens GGW	–	–	–	x	

MOSSES

	JM	HG	SJ	JSE	Others
(*Sphagnum molle* Sull.) = *S. tabulare* Sull.)	x			–	
*Common by freshwater ponds.					
S. subsecundum Ness	–			x	
*As above, perhaps the same plant.					
S. imbricatum Hornsch.	–			x	
*Occasional by fresh ponds.					
Dicranum Bergeri Bland.	x			–	
Leucobryum glaucum Schimp.	x			x	
Ceratodon purpureus Hedw.	x			x	

	JM	JSE
Aulacomnium palustre Schwaeg.	–	x
Bryum inclinatum B. & S.	x	–
(*Webrea pseudo-carnea* Kindb.)	x	–
= *Pohlia bulbifera* (Warnst.) Warnst.		
(*Bryum Knowltoni* Barnes)		
= *B. lacustre* (Web. & Mohr) Bland	x	–
Drepanocladus fluitans Hedw.	x	–
D. aduncus Hedw.	–	x
Perhaps the same as the above species.		

LICHENS

	JM	JSE
Parmelia saxatilis (L.) Fr., v. *sulcata* Nyl.	x	–
On old boards and posts.		
P. physodes L., var. *vulgaris* Krob.	x	x
As above JM; on shrubs and sand JSE		
P. olivacea (L.) Ach., var. *sorediata* (Ach.) Nyl.	x	–
On old boards and posts JM.		
Sticta pulmonaria (L.) Ach.	x	–
On Empetrum.		
Peltigera canina (L.) Hoffm.	x	–
On sandy earth, east end.		
Lecanora subfusca (L.) Ach., v. strynea Ach.	x	–
On fences near sea.		
L. varia (Ehrh.) Nyl.	x	–
On old rails.		
L. varia, var. *symmicta* Ach.	x	–
On old rails.		
Centraria aculeata (Schreb.) Fr.	–	x
Once, on dryish sandhill.		
Cladonia pyxidata (L.) Fr.	x	–
On earth, east end.		
C. fimbriata (L.) Fr.	x	–
On earth, rather rare.		
C. gracilis (L.) Nyl., v. *verticillata* Fr.	x	–
On old land, rather rare.		
C. furcata (Huds.) Fr., var. *subulata* Floerk.	x	–

	JM	JSE
Not uncommon.		
C. uncialis	–	x
Occasional.		
C. rangiferina (L.) Hoffm.	x	x
On earth, frequent.		
C. sylvatica L.	x	–
On earth.		
C. s., var. *alpestris* L.	x	–
On earth, east end.		
C. diformis (L.) Hoffm.	x	–
On earth, old land.		
C cristatella Tuckerm.	x	–
On old land.		
Buellia myriocarpa (DC) Mudd.	x	–
On old boards.		
Xylographia parallela (Ach.) Fr.	x	–
On old fences.		

ADDENDA From Visit of 1953

Vascular Plants: *Potamogeton epihydrus* Raf., var. *Nuttalli* (C. & S.) Fern.; *Zostera marina* L.; *Hordeum jubatum* L., *Spiranthes Romanzoffiana* Cham.; *Lycopodium inundatum* L.; *Polygonum cuspidatum* Sieb. & Zucc.; *P. Persicaria* L.; *Trifolium hybridum* L.; *Calluna vulgaris* (L.) Hull; *Teucrium canadense* L.; *Mentha arvensis* L.; *Plantago lanceolata* L.; *Bidens connata* Muhl., var. *petiolata* (Nutt.) Farw.

Mosses: *Sphagnum Girgensohnii* Russ.; *S. cuspidatum* Ehrn.; *Polytrichum commune* Hedw.; *Dicranum Bergeri* Bland.; *Bryum Bimum* Schreb.; *Mnium hornum* Hedw.; *Drepanocladus exannulatus* (Guemb.) Warnst. and two doubtful and sterile specimens which Dr. Andrews considers to be (1) *Fontinalis* but with some differences both from *F. dalecarlica* Bry. Eur., which furthermore does not normally live in brackish ponds, and from *F. Sullivantii* Lindb., which would be about a thousand miles north of its known range; (2) a small Pleurocarp which the author thought might be *Amblystegium compactum* (C.M.) Aust. but which Dr. Andrews thought nearer to *Eurhynchium praelongum* (Dill L.) Bryhn, as this species was formerly conceived.

Hepatics: *Cladopodiella fluitans* (Nees) Joerg.

PRESIDENTIAL ADDRESS
NOVA SCOTIAN INSTITUTE OF SCIENCE

Alan E. Cameron

90th Annual Meeting, October 22, 1951

Members of the Institute of Science:

In opening this annual review of the activities of our Institute, I should like to call your attention to the fact that we are entering the last decade of a century of activity. We are ninety years old tonight. Yet, as I hope to show, we are younger in spirit, and more vigorous in our activities than at any other time in our history. Moreover, we have a greater opportunity before us, a greater expectation of systematic production in more walks of scientific endeavour than our forefathers could have dreamed of.

First, let me briefly summarize the activities during the past year. It is pleasing to record that, to our knowledge, we have suffered no loss by death in our membership. The vicissitudes of professional life cause changes in habitat and it is natural that there should be changes in membership classification. We open this year with a total membership of two hundred and thirty-six, composed of:

Ordinary members	81
Associate members	62
Student members	67
Life members	14
Honorary members	7
Corresponding members	5
Total	236

This is the highest membership on record and represents an increase of fifteen per cent over last year. This increase in membership has been accompanied by an increase in regular attendance and an increase in the number of papers presented for discussion. We held eight ordinary meetings and one business meeting with an average attendance of forty-six and the presentation of twenty-five papers contributed by thirty-five authors.

I must pay tribute next to the other officers and to the council for their contributions to the Institute during the past year. Nine council meetings were required to handle the routine business and special problems. Reports from the officers will be presented shortly. All will be of interest; all represent conscientious and time consuming work. I call your special attention to the report of the corresponding secretary. Having brought the exchange list up to date, he turned his attention to an accumulative index of the proceedings of the Institute, and after two years' work, has it finished. This is the first of its kind, in our Institute activities and, when published, as it must be, it will be a valuable contribution to our proceedings. I know that in doing this piece of work he will have come across many interesting, historical items, and I sincerely trust that he, some evening, will give us a review of his findings.

You will be pleased to hear from the Editor that our proceedings are up to date with the 1949-50 Part IV of Volume XXII printed and distributed, and Part I Vol. XXIII for 1950-51 well in hand. When you learn that he has brought this work up to date during the same time that he and another member of the Institute have been busily engaged in final editing and proof reading of an important new text book in his own field, you will realize the sacrifice he made for Institute Affairs.

Last to receive special mention, but by no means least, is our recording secretary. To him goes the credit for keeping the Institute active and energetic. He retires tonight after five years of outstanding service and is fully entitled to all the thanks we can give.

May I now return to my earlier theme, that of present scientific activity as a promise to the future. In his Presidential Reports for 1949 and 1950, Dr. Weld outlined a coming expansion in research facilities in this (Halifax) area. He mentioned the Nova Scotia Research Foundation, the Fisheries Experimental Station, Naval Research Establishment of the Defence Research Board of Canada, the new laboratories of the Nova Scotia Technical College, the new Department of Metabolism at the Victoria General Hospital, and the new laboratories of the National Research Council on Dalhousie Campus. Each of these deserves more attention than I can give it now. The time is not far distant when special meetings will have to be called to permit the Institute members to visit and to inspect these new and growing facilities. By so doing we will become more than ever conscious of the growing influence science has upon our everyday life. Only a day or two ago, a number of those present had the privilege of visiting and inspecting the highly scientific but industrial plant of Cossor (Canada) Ltd. There, we saw the adaptation of modern physical science to industry.

The program of papers, although still largely from biological and medical science, showed the influence of the workers in these organizations. They contributed twenty-four per cent of the papers presented to the Institute. We welcomed papers on oceanography from the Naval Research Establishment, papers from the Fisheries Experimental Station, and papers covering results of investigations on Nova Scotia forestry and geology, the result of work done under the sponsorship of the Nova Scotia Research Foundation We can look forward with confidence, to further contributions from these active and fast growing services.

An outstanding innovation in Institute procedures was the holding of a regular meeting at Wolfville, where we were the guests of the local associate members. This scheme, first suggested by Past President R. J. Bean some years ago, was undertaken in the Spring and was completely successful. A series of papers prepared by the local (Wolfville) members was followed by a social gathering where we renewed acquaintances and made new friendships and incidentially added new members. Without doubt, this innovation has shown a new way by which the Institute can give service to the scientific workers in the Province.

Ladies and gentlemen, the Institute has a vital part to play in scientific life of Halifax and the Province. It can and should supply the link of contact between workers in the various fields. It can and should be a vehicle for the distribution of scientific contributions from the workers in Nova Scotia. We may need more meetings. We may need sectional meetings. We certainly need to put forth every effort to see to it that the workers have an opportunity to present their problems, to express their opinions, to announce their findings.

These laboratories and institutions of Nova Scotia are, after all, a compact group of scientific workers, relatively isolated from contact with other workers in their own fields but, I am sure, capable of producing results that could make the name of the Nova Scotia Institute of Science known wherever scientists gather together. Let us all put our shoulders to the wheel so that at the end of the next ten years, when our own hundredth Anniversary comes around, people will flock to our centenary gathering from all corners of the world.

PROCEEDINGS OF MEETINGS

Session of 1951-52

90th Annual Business Meeting, October 22, 1951.

The President, Dr. Alan E. Cameron conducted the meeting and fifteen members attended. His annual address is printed in full in the proceedings.

The Secretary announced the election of Mr. C. M. Goethe as Life member by Council on May 7.

Reports of Officers were presented and are summarized as follows:

The Treasurer reported that:

Receipts were	$ 1,015.02
Expenditures were	2,208.57
Total assets, current account	753.07
Total assets, permanent fund	4,000.00

The Corresponding Secretary reported that ten new exchanges were set up during the year, bringing to 540 the total number of institutions receiving the Proceedings. A considerable number of back files was sent out. The index to the Proceedings from 1862 to 1950 was complete.

The Editor reported that Parts 3 and 4 of Volume XXII were published and distributed.

The Librarian reported that he had been nominated to the Library Committee of the Nova Scotia Research Foundation. He reported that a new catalogue of Scientific Periodicals in the Libraries of the Maritime Provinces will contain a complete list of the holdings of the Institute.

Officers elected for the year 1951-52 were:

President:—Dr. A. E. Cameron
1st. Vice-President:—Dr. W. J. Chute
2nd. Vice-President:—Dr. H. D. Smith.
Treasurer:—Dr. J. R. Dingle.
Corresponding Secretary:—Dr. J. G. Aldous.
Recording Secretary:—Dr. J. A. McCarter.
Editor:—Dr. H. R. Chipman.
Librarian:—Dr. W. J. Chute.
Council:—Dr. W. L. Ford, Mr. R. A. Hornstein, Dr. P. L. Hoogland, Dr. J. G. Kaplan, Dr. A. D. MacDonald.
Auditors:—Dr. E. G. Young and Dr. H. L. Bronson.

1*st Ordinary Meeting*, November 12, 1951.

The following new members were announced (elected by Council October 30): E. G. Bligh, B.Sc., Miss Margaret Cullens, B.Sc., Miss Beryl Truscott, M.A., J. W. Haynes, M.A., Miss Rosalie Triggs, M.S.A., J. Spitzer, M.D., Clarke Corliss, Ph.D., J. C. Szerb, M.D., and D. E. Ryan, Ph.D., Ordinary members. Miss E. Roitman, B Sc., M. Civen, B.Sc., F. B. Fisher, B.Sc., and G. A. Dauphinee, B.Sc., Student members.

Papers: "Hemolysis by Heparin in Lipemic Animals" by C. B. Weld, John Spitzer and Hazel Jones: "Some Recent Mineral Investigations in Nova Scotia, by E. Lee Cameron; "the Unsaturation Value versus Refractivity Relationship of Unsaturated Fatty Acids and its Implications," by F. A. Vandenheuvel.

2*nd Ordinary Meeting*, December 10, 1951.

It was announced that Council had elected, on December 10, Professor R. J. Bean and Dr. J. H. L. Johnstone to Honorary membership; Hon. Henry D. Hicks, D. B. MacLean, Ph.D., O. Knop, E. Lee Cameron, R. V. Dexter, M A , J. D. Holland, M A , C. R. Masson, Ph.D., A. N. O'Neill, Ph.D. D. A. I. Goring, Ph.D., Ordinary members.

Papers: "Electrical Breakdown of Neon at High Frequencies," by D. D. Betts and A. D. MacDonald: "Inhibition by Sodium Nitrite of the Enzymic Reduction of Trimethylamine Oxide," by C. H. Castell: "A Comparison of the Effects of Ultraviolet and X-ray radiations upon some Enzymes of the Yeast Cell," by J. G. Aldous and K. D. Stewart.

3rd Ordinary Meeting, January 21, 1952

The following new members were announced (elected by Council January 21): F. G. Millar, D. C. West, M.A., Miss M. Douglas, B.Sc., Ordinary members; E. H. Anthony, B.Sc., P. R. Sweeney, M. Gibson, Miss M. Stead, R. E. Foote, R. Kerr, Miss J. Ellis, J. C. Taylor, C. Duval, A. Cunningham, A. W. Gord, G. A. Guptill, B. H. Matheson, Student members.

Papers: "Exchange of Phosphorus Between Water and Mud in Lakes," by J. R. Hayes and M. L. Cameron: "A Chemical Studies on the Structure of Lycopodium Alkaloids", by D. B. Maclean and H. C. Prime: "X-ray Diffraction Studies on the Lycopodium Alkaloids", by O. Knop and P. M. Beatty.

4th Ordinary Meeting, February 11, 1952.

The following new members were announced (elected by Council February 11) E. L. Heighton, M.Sc., Ordinary member; M. F. Dolan, J. M. Reeve, Student members.

Papers: "A Nutritional Survey of Children in Halifax," by Thelma Allen and E. Gordon Young: "Some Considerations on Schrodinger's Equation", by W. J. Archibald; "Changes in the Electrophoretic Patterns of Plasma Proteins in Hepatectomized Frogs" by John J. Spitzer.

5th Ordinary Meeting, March 10, 1952.

The following new members were announced (elected by Council March 10) Stewart Morse, Lawson Nichols, Ordinary members.

Papers: "Fibrous Protein in Amphibian Morphogenesis," by J. G. Kaplan; "Location of Herring by Sonic Sounder," by A. H. Leim; "On the Occurrence, Nature and Origin of Cold, Low Salinity Masses Adjacent to the Gulf Stream," by W. L. Ford, J. R. Longard and R. E. Banks.

6*th Ordinary Meeting*, April 7, 1952.

The following new members were announced (elected by Council April 7) Ian S. Robb, M.D., John Dorozynski, B.Sc., J. L. Martin Ordinary members.

Papers: "The Distribution and Taxonomic Relationship of the Amphibians and Reptiles of Nova Scotia" by J. S. Bleakney: "The Effect of Freezing on the Sulphate-Chlorinity Ratio of Sea Water," by H. J. McLellan; "Factors Responsible for the Ascent of Salmon in the LaHave River," and "The LaHave, a Colour-Sound Film of Salmon Investigation," by F. R. Hayes.

Extraordinary Meeting, April 22, 1952.

Professor Sir Geoffrey I. Taylor addressed the Institute on the topic "The Mechanics of Animals Swimming."

7*th Ordinary Meeting*, May 5, 1952.

Papers: "Mineral Constituents of Some Land Gastropods," by D. Pelluet and J. S. Tait; "Service Performance of Cast Magnesium Anodes in the Cathodic Protection of Ships," by G. L. Christie; "The Heparin-produced Lipemia Clearing Factor," by J. J. Spitzer.

ABSTRACTS

(Papers presented before the Institute but not published in the Proceedings)

THE UNSATURATION VALUE VERSUS REFRACTIVITY RELATIONSHIP OF UNSATURATED FATTY ACIDS AND ITS IMPLICATION. F. A. Vandenheuvel. The unsaturation value of the methyl ester of unsaturated fatty acids of natural origin is a linear function of the refractive index. The relationship covers the whole range of unsaturation from one to six double bonds. There are several important implications. Some are purely analytical, others concern the structural character of the acids. Whatever the precise significance of this relationship it offers a trustworthy means of detecting structural changes and of deciding whether a compound is a natural one or a secondary one.

SOME RECENT MINERAL INVESTIGATIONS IN NOVA SCOTIA. E. Lee Cameron. Technological advances and the higher prices paid for most metals and minerals have, in recent years, brought into production many mineral deposits that were formerly considered marginal or sub-marginal in tenor. The new methods of benefication and concentration have been applied to several Nova Scotia ores in the past two or three years. A variety of ores and minerals have been tested, including galena, stibnite, calcocite, feldspar, quartz, barite, garnet and clay. In several cases the work was carried through to pilot plant scale operations before a decision regarding the economical possibilities of an individual deposit could be decided.

HEMOLYSIS BY HEPARIN IN LIPEMIC ANIMALS. C. B. Weld, John Spitzer and Hazel Jones. Bloods taken after the intravenous injection of 200-250 units of heparin to dogs exhibiting alimentary lipemia, are usually hemolysed to a slight or moderate degree, whereas no hemolysis is obtained if the injection is made in normal dogs.

The phenomenon was studied as follows.

(1) Heparin added directly to washed red cells caused no hemolysis.

(2) Threshold values of sodium glycocholate, saponin, or sodium oleate as hemolytic agents were determined on washed red cells. The addition of heparin did not increase the hemolysis.

(3) The protective value of the dog's serum or plasma against hemolysis by sodium glycocholate, was determined. This was found to be reduced by about thirty per cent after the intravenous injection of heparin to lipemic dogs while it was actually increased by about fifteen per cent when the heparin was given to normal dogs.

It is concluded that the hemolytic action of heparin is due to its effect on the plasma, probably through its action on the lipo-protein complex.

INHIBITION BY SODIUM NITRITE OF THE ENZYMIC REDUCTION OF TRIMETHYLAMINE OXIDE. C. H. Castell. (1) A series of experiments were performed showing the effect of the following factors on the rate of trimethylamine oxide reduction: type of bacteria; age of cell crop; washing; aeration; temperature; pH; sodium nitrite; hydroxylamine.

(2) An effort was made to discover the mechanism whereby nitrite inhibits this reaction. It was found that inhibition occurred only where the organisms were nitrite reducers. A similar result was found when nitrite was used to inhibit the bacterial reduction of cysteine to hydrogen sulphide. Nitrite inhibited the reduction of the oxide only when it exerted a poising action on the O/R potential as indicated by inert platinum electrodes. There was no evidence to show that the nitrite was reduced to hydroxylamine, and that this latter substance was the actual enzyme inhibitor, as has been suggested. (3) In a series of tests, evidence was accumulated suggesting that the nitrite exerted its inhibition on the dehydrogenases involved in the system.

Electrical Breakdown of Neon at High Frequencies. D. D. Betts and A. D. MacDonald. The breakdown electrical fields in pure neon gas at a frequency of three thousand megacycles and at pressures varying from one tenth millimetre to two hundred and fifty millimetres of mercury have been measured. This paper describes the basic gas discharge phenomena and the experimental procedures followed. The experimental data presented are compared with theoretical predictions.

A Comparison of the Effects of Ultra Violet and X-Ray Radiations upon some Enzymes of the Yeast Cell. J. G. Aldous and K. D. Stewart. Suspensions of resting cells of Baker s yeast were exposed to the two million volt X-ray machine at the N. R. C. Laboratories at Chalk River, Ont. The total dose of X-rays was calculated to be 72,000r given over a period of six minutes. This dose resulted in a population viability of the order of fifty per cent. The subsequently dried material was submitted to a series of extraction procedures, which have been previously described, for the preparation of various enzyme solutions.

A comparison of the specific activities of the enzymes prepared from the X-irradiated yeast with those prepared from ultra violet irradiated yeast indicates that those enzymes resistant to ultra violet light are also resistant to X-rays. This is a surprising finding in view of the difference in mechanism of action of these two forms of radiation.

Exchange of phosphorus between Water and Mud in Lakes. F. R. Hayes and M. L. Cameron. Undisturbed mud-water cores were collected in glass cylinders and brought to the laboratory. Radiophosphorus was added to the water and the rate of its uptake by the mud followed.

The tendency of mud as a non-living entity, is to exchange phosphorus throughout its depth. In the absence of bacterial activity this exchange is assumed to operate only in the soluble phosphorus fraction. Both bacteria and higher plants tend to hold the phosphorus concentration in the water in a state of equilibrium, the level of this steady state depending on the amount of living material present in the system. While higher plants, etc., may bring the equilibrium concentration almost to zero, the role of bacteria is that of regenerators, so that the higher the concentration of bacteria, the higher the concentration of phosphorus returned to the water. In this process, bacteria act as reducers of oxygen and tend to remove it from their environment.

There is enough phosphorus bound in the lake mud to greatly increase the productivity of the water if it could be released there. As bacterial action takes place most efficiently on surfaces, a scheme by which the surface of the lake bottom could be increased might have the same effect as fertilizing the water. A fertile lake is not necessarily one with a high phosphorus concentration in the water; if the green plant and plankton crop is high, the phosphorus content of the water may be low in any lake.

X-RAY DIFFRACTION STUDIES ON THE LYCOPODIUM ALKALOIDS. Osvald Knop and Patricia M. Beatty. As the chemical constitution of these alkaloids is, with the exception of a few functional groups, not known, the X-ay diffraction study presents a problem of considerable complexity. Only a few compounds have so far been successfully studied by X-ray methods under comparable conditions. The outstanding example was the complete determination of the structure of penicillin.

A general survey of the symmetry and of the unit cell dimensions of the principal alkaloids of the Lycopodium family, and of some of their salts, has been carried out. Since annotinine has been the alkaloid most exhaustively studied by chemical methods, it was selected for the study by Fourier techniques.

Suitable single crystals of annotinine hydrobromide and annotinine hydroiodide were prepared for this purpose. Although a definite proof has not yet been obtained, the two salts appear to be isomorphous. The positions of the four bromine atoms in the orthorhombic unit cell of the hydro-bromide were ascertained by the use of modified two-dimensional Fourier series. This procedure alone yielded some information about the shape of the molecule of annotinine. Assuming that the two salts are isomorphous, the signs of the unmodified Fourier terms can be calculated. This will then make it possible to prepare a projection of the electron-density distribution function on the largest face of the unit cell of the hydrobromide. From this, the positions of some of the carbon atoms will be located.

CHEMICAL STUDIES ON THE STRUCTURE OF LYCOPODIUM ALKALOIDS. David B. MacLean and H. C. Prime. The Lycopodium alkaloids are one of the few remaining groups of alkaloids of unsolved structure. The present investigation is concerned with some preliminary studies on one of the major alkaloids of this group, annotinine.

Various attempts to degrade the molecule by attack on reactive functional groups in the base and some of its derivatives are described. From these observations partial structures involving the nitrogen atom and the functional groups are postulated.

A NUTRITIONAL SURVEY OF CHILDREN IN HALIFAX. Thelma Allen and E. Gordon Young. A nutritional survey has been conducted on one hundred and one children, aged one to six years in the poorer areas of Halifax, N. S., during 1949-1951. Roentgenograms of the bones of the hand and wrist have been assessed in terms of degree of ossification. All observations have been repeated after six months as a criterion of dietary adequacy.

The most important deductions are as follows: (1) Calories were below the Canadian standard by 200-400. They averaged 77 per kgm. (2) Protein was generally adequate at 2.5-3.0 gm. per kgm. (3) Calcium was at the standard level in only 20 per cent of the cases, but phosphorus reached it in 60 per cent. (4) Iron was notably substandard in 2-3 yr. olds. (5) Of the vitamins, A, B_2, B_2, C and niacin were usually adequate. D was consumed at or above 400 I.U. per day in only 15 per cent of the children. The amount ingested averaged 16 I.U. per kgm. and varied from 5 to 18 I.U.

The group tended to be lighter and smaller than the Baldwin-Wood averages. Considering all factors, fifty per cent showed adequate growth on substandard diets but thirty per cent did not. Normal ossification may proceed on intakes of 25-150 I.U. of vitamin D, and 0.2-0.7 gm. of calcium.

Some Considerations on Schrodinger's Equation. The Schrodinger wave equation of Quantum mechanics was first written down by analogy from the corresponding equation in wave optics. The analogy was suggested by the work of deBroglie who associated a wave of length $\lambda — h/\sqrt{2m(E-V)}$ with a material particle of mass m, total energy E, and potential energy V. If, in addition to the term V, one adds terms in $\frac{dV}{dx}$ and $\frac{d^2V}{dx^2}$ in the problem of the Hydrogen atom, the shift in the energy levels thus obtained can be shown to be equivalent to those given by the first order relativity correction and the spin orbit coupling correction respectively.

Changes in the Electrophoretic Patterns of Plasma Proteins in Hepatectomized Frogs. John J. Spitzer. The purpose of the experiments was to study the changes in blood proteins induced by hepatectomy.

Our knowledge of the role of the liver in regenerating plasma proteins is based mostly on observations on dogs (which survive hepatectomy only for a very short time) and observations on patients having liver diseases (mostly cirrhosis).

We have chosen frogs as experimental animals because of their ability to survive the removal of liver for several days. In these experiments the maximum period of survival was six days. It should be noted, however, that there was a striking difference between summer and winter frogs, the latter group surviving hepatectomy in a much smaller percentage and for a much shorter time, than the former one.

The results of these experiments indicate a definite increase in the globulin fraction of electrophoretic patterns. This increase concerns primarily the gamma globulins. A slight decrease was revealed in the amount of albumins after hepatectomy.

Comparing the above results to the previous ones in this field, an agreement is shown as far as globulins are concerned. On the other hand, there was but a slight decrease in the albumin content.

Location of Herring by Sonic Sounder. A. H. Leim. It has been known since 1935 that pelagic fish schools may be detected by sonic sounding gear. This method has now come into general commercial use and was also used for exploration of the Gulf of St. Lawrence, in particular, for herring. Massive, as well as small, schools have been located at various seasons in this area where herring were known to be abundant in spring in the Maritime provinces and in fall and winter on the west coast of Newfoundland. No large concentrations, comparable to these, have been located at other times of the year. The paper deals with the methods used and the results obtained during several years of exploration.

On the Nature, Occurance and Origin of Cold Low Salinity Water Along the Edge of the Gulf Stream. W. L. Ford, J. R. Longard and R. E. Banks. Immediately adjacent to the left side of the Gulf Stream looking downstream there occurs often a narrow band of relatively cold water which has been attributed to upwelling from the colder depths of the ocean. Recent investigations throw doubt on this explanation since this water, which forms a thin layer close to the surface, may have a lower salinity than any water in the depths. Evidence is given to show that the only cold, low salinity source is the so-called shelf water, which is found in a broad band between the shore and a rather indefinite boundary off the continental shelf. It appears that the cold, low salinity water adjacent to the Stream, mixes with the latter, and this product is discharged to the left of the Stream as one of the sources of the slope water which lies between the Gulf Stream and the shelf.

The investigation indicates that there is a much more intimate relationship between the shelf water, the Gulf Stream and the slope water than had previously been suspected, and that all of these masses should be considered as a single system.

Fibrous Protein in Amphibian Morphogenesis. J. G. Kaplan. It has been reported in the literature that a fibrous protein fraction appears in the frog embryo at the time of formation of the neural plate, the first stage in the development of the nervous system. It was thought that this protein fraction might be related to the actual morphological event of elongation of the presumptive neural plate cells. Jelly-free eggs of *R. pipines* were homogenized and extracted in buffered saline, following the procedure of Gregg and Ballentine. The insoluble residue contained the fibrous protein, yolk, and some pigment granules. The fibers could be separated from the yolk since the former were completely insoluble in 10% NaC1 (contrary to the preliminary findings of Barth and Jaeger), in which the latter was completely soluble. The fibrous protein was found in the unfertilized egg, and throughout development, increasing steadily to the hatching stage (stage 20). No sudden increase was observed at neurulation (stages 13-14). Consequently it cannot be regarded as being exclusively connected with morphogenesis of the nervous system. Since total insoluble nitrogen and total soluble N remain constant in the stages studied, it is believed that the fibrous protein is elaborated at the expense of the yolk. Four fractios were tested for adenosine-triphophatase activity: a) ultra-centrifugable granules, b) soluble fraction (after centrifugation at 20,000 x g), (c) reprecipitated yolk, (d) fibrous protein fraction. All the ATPase activity was found in the ultra-centrifugable granules.

The Distribution and Taxonomic Relationships of the Amphibians and Reptiles of Nova Scotia. John Sherman Bleakney. A survey of amphibians and reptiles was conducted over the entire province of Nova Scotia during the summer of 1950. In addition, collections have revealed the following situation; studies have been made of the amphibians and reptiles of the United States and Northern Canada but very little has been done in the Maritime Provinces. Apparently Nova Scotia is an intermediate zone since many of the species collections were made during the winter and spring at Wolfville, and from April 9 to 14, 1951 in the counties of Queens and Annapolis. This work was carried out to fulfill the thesis requirements for a Master s degree at Acadia University and the expenses were paid by the Nova Scotia Museum of Science. Prior work in this field consisted of a list of the Amphibians and Reptiles of Nova Scotia published by A. H. MacKay in 1896, taken from a collection in the Pictou Academy. This collection was lost by fire and there remained only a small collection at the Nova Scotia Museum of Science to represent the Nova Scotian Amphibians and Reptiles.

The 1950 survey improved this situation by adding to the Museum collection a representative series of two thousand four hundred specimens consisting of twenty-two species, nine of which had not been reported for Nova Scotia before.

In the thesis, all the known herpetological papers pertaining to work in Nova Scotia are discussed in detail. The body of the thesis is devoted to individual treatment of each species. Pertinent information on classification, history of nomenclature in Nova Scotia, number of specimens collected, distribution, lise history, measurements and sex determination is presented and discussed.

The collections have revealed the following situation; studies have been made of the amphibians and reptiles of the United States and Northern Canada but very little has been done in the Maritime Provinces.

Apparently Nova Scotia is an intermediate zone since many of the species collected have characters relating to both the northern and southern regions.

Some exhibit northern characteristics which have not been reported before for the species, namely, overwintering of the tadpoles of the Pickerel Frog, and the larvae of the Spotted and Jefferson's Salamanders. Weather maps show that the Annapolis Valley and south-central Nova Scotia have the least severe weather conditions in the Maritimes, and it is in these areas that the centers of abundance of both numbers of species and numbers of individuals of those species are found. Smaller local pockets of abundance of certain species were found throughout the province. The discovery of the Eastern Ribbon Snake, usually recorded as extending northwards only to southern Maine, as a common species in south-central Nova Scotia led the author to believe that during the last warm period (sub-Boreal of five to three thousand years ago) the present day amphibians and reptiles, including the ribbon snake, were common over most of the Maritime Provinces, and that during the subsequent years cooling temperatures eventually limited them to certain favourable regions, Maine and Southwards and the South-central part of Nova Scotia.

From the findings of this study the Author has been able to divide Nova Scotia into nine distinct herpetological sections. These sections are listed with their characteristic herpetofauna, geology, type of flora, and weather conditions.

A key to the adult amphibians and reptiles of Nova Scotia is included.

THE EFFECT OF FREEZING ON THE SULPHATE-CHLORINITY RATIO OF SEA WATER. H. J. McLellan. Experimental freezings where natural conditions were closely simulated confirm that there is a selective retention of sulphate in sea ice with consequent increase in the SO_4/Cl ratio for melt waters and decrease for waters under the ice cover. Associated density variations were inconsistent with this ionic shift and are not explained. Observations of the ratio in waters of the Canadian Atlantic demonstrate the effect of ice formation on these waters.

FACTORS RESPONSIBLE FOR ASCENT OF SALMON IN THE LAHAVE RIVER. F. R. Hayes. A counting fence was operated on the LaHave River for several seasons to determine the causes of salmon ascent. The fish generally enter the river after rains. Artificial freshets to simulate rains were successful in moving salmon from the estuary but not from the outer bay. Onshore winds of twenty-five miles per hour or more cause salmon to enter the river. The change from daylight to dusk also promotes migration. In the spring and autumn the migrants are chiefly salmon of about ten pounds, with two years sea life. In summer only grilse are observed (one year sea life).

MINERAL CONSTITUENTS OF SOME LAND GASTROPODS. D. Pelluet and J. S. Tait. Quantitative determinations were made of the sodium, calcium and phosphorus content in four species of slugs. Three elements were measured with a flame photometer. Phosphorus was measured with a Lumetron colorimeter. Samples were ashed with nitric and perchloric acids. Sodium concentration in adult slugs is about one tenth that reported for Warine gastropods. Potassium concentration is somewhat lower, and calcium concentration is comparable to that of marine gastropods. Small individuals of the species Arion subfuscus have about ten times the sodium concentration of large individuals. A similar trend is indicated for calcium. Ovotestis determinations were similar to those for whole animals.

SERVICE PERFORMANCE OF CAST MAGNESIUM ALLOY ANODES IN THE CATHODIC PROTECTION OF SHIPS. G. L. Christie. Cathodic protection of inactive ships using magnesium anodes is now a routine matter with the R.C.N. Several magnesium protection systems have been installed on active ships which from a corrosion point of view have been very successful. The behaviour of the anodes in these trials have not been entirely satisfactory. The paper describes some of the defects that have been encountered and indicates some of the corrective measures that have been applied.

THE HEPARIN-PRODUCED LIPEMIA CLEARING FACTOR. John J. Spitzer. Dept. of Physiology, Dalhousie University, Halifax, N. S. Injection of heparin abolishes visible lipemia. Heparin has this effect only in vivo. The serum of heparin injected animals has the potency to clear lipemia in vitro. Making use of this finding the following properties of the heparin-produced clearing factor were found: it is not dialysable, it is found in albumin fraction of the serum, 49°C inactivates it irreversibly, and thrombin or thromboplastin do not affect its activity.

NA-H[alifax]

PROCEEDINGS

OF THE

Nova Scotia Institute of Science

HALIFAX, NOVA SCOTIA

VOL. XXIII. 1952-1953 PART 3

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Editor: H. Ritchie Chipman
Editorial Board: H. L. Bronson, Dixie Pelluet and J. A. McCarter
Printed for the Institute by Rolph - Clark - Stone Maritimes, Limited
Date of Publication: February 1954

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PROCEEDINGS
OF THE
Nova Scotian Institute of Science
SESSION OF 1952-53
(VOL. XXIII, Part 3)

THE LEPIDOPTERA OF NOVA SCOTIA

PART I, MACROLEPIDOPTERA

D. C. Ferguson
Nova Scotia Museum of Science

Received for Publication February 6th, 1953

INTRODUCTION

The Historical Aspect

On May 2, 1864, the first paper dealing exclusively with the lepidopterous fauna of Nova Scotia was read before the Nova Scotian Institute of Natural Science, by Thomas Belt. It was an annotated list of thirty species of butterflies observed by that author in the vicinity of Halifax during 1862 and 1863. This was followed in relatively quick succession by seven other papers, most of them dealing solely with the Lepidoptera of this area. The last of these appeared in 1915—thirty-eight years ago, so ample time has elapsed to justify the writing of another, incorporating the wealth of information since accumulated, together with the inevitable changes in nomenclature that occur during so long a period.

The following are the eight previously published papers, in chronological sequence:

Belt, Thomas. List of Butterflies observed in the Neighbourhood of Halifax, Nova Scotia. Trans. N. S. Inst. Sc., Vol. I, pt. 2, pp. 87-92, 1864. (Thirty species mentioned).

Bethune, Rev. Charles J. S. Nova Scotian Lepidoptera, with Additional Notes by J. Matthew Jones. Ib., Vol. II, pt. 3, pp. 78-87, 1869 (seventy-nine species mentioned, seven of which are butterflies).

Jones, J. Matthew. Review of Nova Scotian Diurnal Lepidoptera. Ib., Vol. III, pp. 18-27, 100-103, 1871-72 (thirty-five species mentioned).

The name of the Institute has inadvertently been printed on the cover as Nova Scotia Institute of Science instead of Nova Scotian Institute of Science. Please accept our apologies.

Silver, Arthur P. List of Nova Scotian Butterflies. Ib., Vol. VII, pp. 86-88, 1888 (forty-six species listed, without further data).

Bethune, Rev. Charles J. S. Butterflies of the Eastern Provinces of Canada. 25th Annual Report of the Entomological Society of Ontario, pp. 29-44, 1894 (about forty species mentioned as occurring in N. S.).

Eaton, Miss Lucy C. The Butterflies of Truro, N. S., with Remarks by Harry Piers Regarding a Few of the Species Mentioned. Trans. N. S. Inst. Sc., Vol. IX, pp. XVII—XXI, 1895 (twenty-six species mentioned).

Perrin, Joseph and Russell, John. Catalogue of Butterflies and Moths Collected in the Neighbourhood of Halifax and Digby, Nova Scotia. Ib., Vol. XII, pt. 3, pp. 258-290, 1909 (fifty-three species of butterflies and four hundred and eighty moths, including Microlepidoptera, mentioned).

Perrin, Joseph. Additions to the above catalogue. Ib., Vol. XIV, pt. I, pp. 49-56, 1915 (about sixty two additional species mentioned, including Microlepidoptera).

Little is known about the work of most of these earlier collectors apart from what their published papers disclose.

Miss Lucy C. Eaton made a general collection of insects at Truro sometime during the final decade of the last century. This collection gathered dust and was largely destroyed by *Dermestes* beetles before the author had the opportunity of going over it several years ago. It contained little in the way of interesting records.

A Lieut. Redman evidently collected in Nova Scotia sometime before 1862, and from his material Francis Walker, of the British Museum, described a number of new species, the types of which were deposited in the collections of that institution. The exact locality where these specimens originated is not known, but they might have come from the vicinity of Halifax.

Andrew Downs (1811-1892), probably the most eminent Nova Scotian naturalist of his day, made a small collection of insects near Halifax, but like the Eaton collection, this was largely destroyed. The specimens had no data labels. Mention is made, however, of a few interesting Downs records that seemed likely to be authentic.

Some interesting captures were made at Sydney, N. S. around 1900 by Miss Margaret Brown, a botanist and specialist in mosses, now of Halifax. These records are acknowledged in the text.

The late Mr. E. Chesley Allen, another well known Nova Scotian naturalist, specialized in Crambinae, but also collected a few Macrolepidoptera at Deerfield, Yarmouth Co. almost 40 years ago.

The numerous references to MacNab's Island, at the mouth of Halifax Harbour, are based on the small but neatly kept collection made there by the late Mr. Joseph Perrin, chiefly between 1900 and 1933. His material is now incorporated in the collection of the Nova Scotia Museum of Science. A perhaps even greater contribution in number of interesting records has been made by Mr. John Russell of Digby, who is responsible for nearly all the records from that locality. A good part of his material is now in the Nova Scotia Museum of Science and the Canadian National Collection, and has been examined by the author.

Another amateur lepidopterist of importance was the late Mr. H. G. Payne, former Provincial Apiarist, who collected most of the specimens recorded from Truro and part of those from Granville Ferry, Annapolis County, over a long period during the first half of the century.

An extensive survey of Lepidoptera was carried out in Nova Scotia from 1934 to 1946 by Dr. J. McDunnough, accompanied some seasons by Dr. T. N. Freeman of Ottawa. The main collecting stations were at White Point Beach, Queen's County, Petite Riviere, Lunenburg County, South Milford, Annapolis County, Parrsboro, Cumberland County and Baddeck, Victoria County. A list of the species of Lepidoptera from Nova Scotia in the Canadian National Collection, Dominion Department of Agriculture, Ottawa, with accompanying data, was kindly furnished the author several years ago, and it proved immensely valuable in extending the known ranges of numerous species within the Province.

Mr. T. Keilor Bentley of Halifax, friend and companion of the author's earliest collecting years, studied Lepidoptera enthusiastically around Halifax and Springhill from about 1941 to 1945, and a few of his records have been used.

Others whose work has contributed to the compilation of data are: the late Mr. C. B. Hills, who collected in the early twenties (all Stellarton records); Mr. Harold T. Stultz and the late Mr. F. C. Gilliatt, both entomologists of the Dominion Department of Agriculture (nearly all Round Hill and Annapolis Royal records prior to 1941); the late Mr. G. E. Sanders, who collected most of the Bridgetown records; the late Mr. J. Reddin (collected at Armdale from about 1918 to 1923); and the late Mr. Arthur D. Hall (collected moths at Chignecto and Fenwick, Cumberland County and Great Village, Colchester County between 1938 and 1949).

The present writer has collected very extensively in Halifax County during the past eleven years, and in addition has made numerous and often repeated collecting trips to localities elsewhere in the province, the most important of these being: Mount Uniacke (border of Hants and Halifax counties), Wolfville, Aldershot, Centreville, Coldbrook, Aylesford and Auburn, King's County, Lawrencetown, Lequille and Annapolis Royal, Annapolis County, Acaciaville, in the Acacia Valley, Digby County, Lake Kejimukujik, Queen's County, Parrsboro and Glenville (near Springhill), Cumberland County, Bass River and Londonderry Mines, Colchester County, Three Brooks (six miles west of Pictou on Route 6), Pictou County, and Baddeck, Victoria County. Much additional collecting, particularly of diurnals, has of course been carried on to a lesser extent in numerous other localities. It can now safely be said that the fauna of certain portions of Nova Scotia is reasonably well known. Central Halifax County to Mount Uniacke; and thence through the Cornwallis and Annapolis Valleys to Digby is one section relatively well worked. Much material has also been collected in Colchester County between Truro and Great Village, in central Cumberland County, Pictou County and central Cape Breton. The working up of other areas has been rather sketchy. Four outstanding areas still relatively uninvestigated are: (1) The extreme southern end of the province between White Point Beach and Yarmouth, (2) The triangular peninsula that juts southwestward between Chignecto Bay and Minas Channel, (3) Guysborough County, (4) The barren plateaus of Cape Breton Highlands National Park.

Geography

Nova Scotia, occupying about the same extremeties of latitude as the states of Maine and Oregon, is the most easterly portion of North America in which the lepidopterous fauna has been extensively studied. It is, at the present time, the eastern-most state or province in which there lives a resident lepidopterist.

In no part of Nova Scotia is it possible to get much farther than thirty miles from salt water, or one thousand four hundred feet above sea level, a situation that has an influential bearing on climatic conditions. The climate is truly temperate. In the coastal areas especially, the temperature rarely exceeds 90° F. or goes below 0° F. In the Halifax area the temperature rests between 20° and 30° during most of the winter, and frequently climbs well above freezing point, especially during the day. Normally it drops to sub-zero values on only two or three occasions during the winter. In July and August the normal daytime temperature is in the seventies, dropping at night to the fifties. Spring frosts rarely cease before May, or autumn ones begin before mid-October. Inland temperatures, in the areas not immediately adjacent to salt water, tend to be slightly more extreme.

The province receives a generous amount of precipitation, mostly in the form of rain, and normally eighteen to twenty-four inches fall between April and September inclusive. The summers vary greatly, however, in the periods of continued drought or rainy weather that may occur. Fog is another important aspect of the Nova Scotian climate. The southern coastal area is most heavily affected, with up to ninety foggy days per year. This decreases inland and northward to the Northumberland Straight region, which gets by with as few as ten foggy days annually.

The peninsula is all but cut off from neighbouring New Brunswick by Northumberland Straight to the north, and the Bay of Fundy to the south. It is joined only by the narrow Isthmus of Chignecto which, as a bridge with the mainland, is probably not highly functional as far as many insect species are concerned, since it is essentially an open, marshy prairie, cut by numerous muddy, tidal creeks.

Geological and Botanical Influences

Nova Scotia is about equally divided between hard and soft rock areas. The southern half, excluding the Annapolis Valley region, is mainly granite, slate and quartzite. Northward, from the Isthmus of Chignecto to Cape Breton, it is essentially a confusing picture of jumbled sedimentary and metamorphic formations, with only scattered granitic intrusions. The bulk of this northern strip is composed of Carboniferous sandstone, conglomerate and shale. The Annapolis Valley is a fifty mile trough, carved from a bed of much eroded and broken down Triassic sandstone. It is shielded from the Bay of Fundy by a long ridge of Triassic basalt and diabase, Cape Split and Digby Neck forming opposite extremities of this ridge. This same Annapolis Valley sandstone reappears on the north shore of Minas Basin and Cobequid Bay, between Truro and Economy.

Nova Scotia lies within that zone where the northern hardwood forest of eastern North America and the southern edge of the northern coniferous forest meet and intermingle.

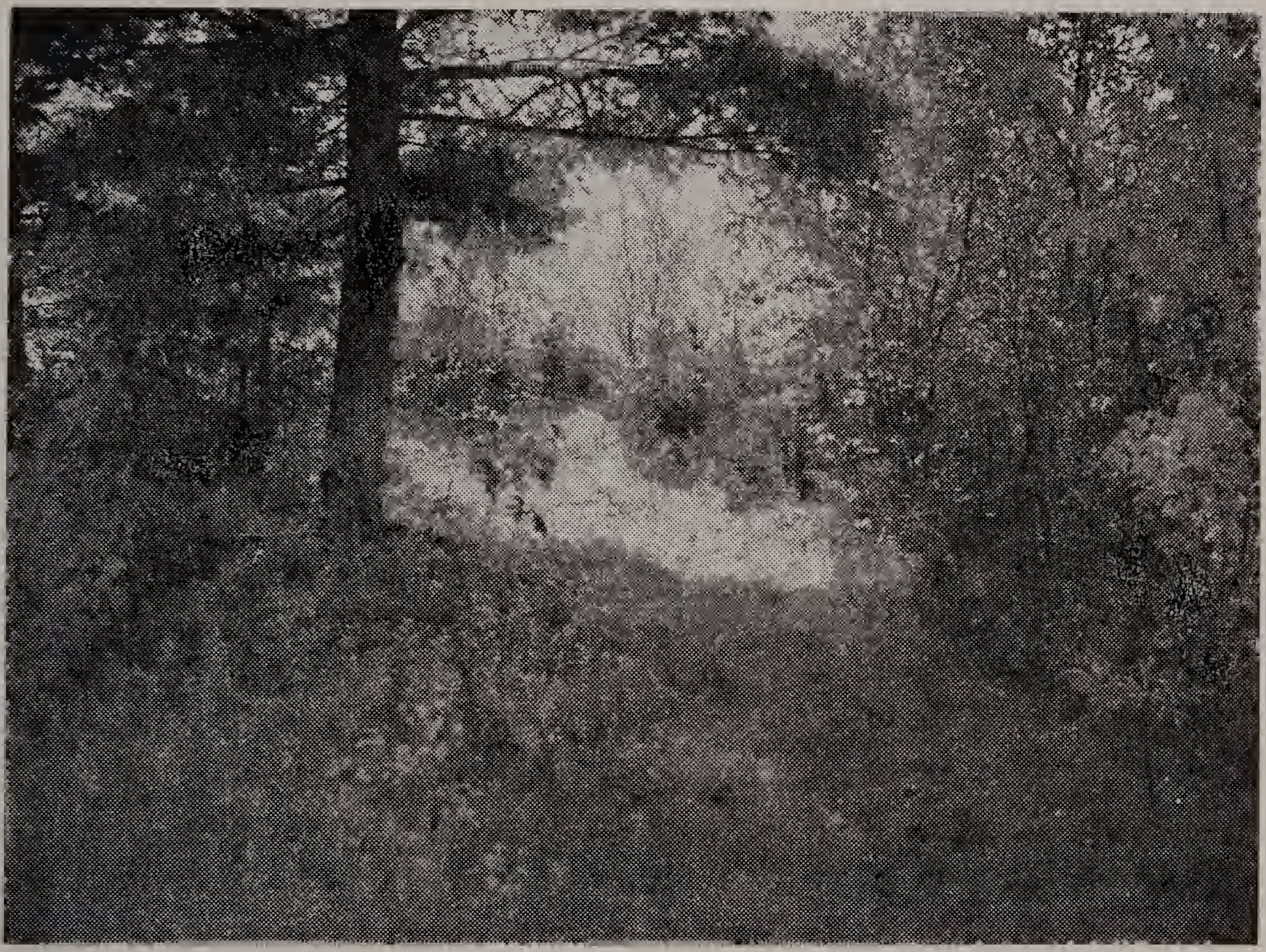


Figure 1. Typical Canadian Zone forest near Centerville, Kings Co. The numerous species recorded from Centerville were taken at light and bait along this old wood road.

This is the so-called Acadian Forest Region. The dominant trees are white and red pine, hemlock, balsam fir, larch, white, red and black spruce, yellow, white and gray birch, poplar, red maple, sugar maple, beech, red oak, *Amelanchier*, and white and black ash. Elm is conspicuous in the fertile river valleys. In effect, Nova Scotia provides a mixture of Alleghenian, Canadian and Hudsonian flora growing in close association. It is a curious contrast to spend an evening on a fog-enshrouded headland, with the crashing of surf continuously in the background, collecting a variety of species that enables one to imagine that the locale is really somewhere in Labrador, and then on the following night journey to another collecting site, perhaps but a few miles distant, and, under a canopy of tall pines, encounter an entirely different moth fauna. Basswood, butternut and hickory have not penetrated the Acadian forest region as far as Nova Scotia and white cedar, although common in New Brunswick, is all but absent.

The character of the lepidopterous fauna changes noticeably from one part of the province to another, and there is a temptation to sub-divide the area into several crudely defined zones. These zones coincide well with the geological divisions described above.

The southern region of granite and quartzite is a mixed zone of northern hardwoods and conifers. In general the forest is mixed, but almost pure stands of spruce, hemlock, pine, beech or oak may occur in suitable situations. The soil tends towards acidity, and there are abundant bogs and black spruce-larch swamps. Ericaceae grow in profusion wherever the forest has been cut or burned. Wherever the underlying rock is slate, rather than granite or quartzite, the deciduous portion of the forest tends to be somewhat more varied, with the appearance of *Corylus*, *Cornus*, *Crataegus* and ironwood. That part of Halifax County where extensive collecting has been carried on lies partly on granite and quartzite, and partly on slate.

The Annapolis Valley changes very little throughout the fifty miles of its length from Kentville to Annapolis Royal. The red sand provides excellent soil for red and white pine, but the magnificent forest that must once have filled much of the valley has been reduced to a few scattered second growth stands. With relation to the other areas, the vegetation of the Annapolis Valley is southern in character. Oak, ash, elm, hawthorn, witch hazel and sumach grow more commonly than in most other parts of Nova Scotia. In the central part of the valley there are miles of open sandy plain, carpeted with broom crowberry (*Corema conradii*) and sweet fern, and interrupted here and there by groves of pine, oak or scrubby *Betula populifolia*, aspen or willow. The main concentrations of oak and ash feeding species seem to occur in the Annapolis Valley region, especially in Annapolis County.

Pine feeders are also very prevalent there but in general these may occur about groves of white pine anywhere, whereas a few of the oak and ash feeding species actually seem limited to the lower Annapolis Valley.

The moth fauna in that portion of Colchester County between Truro and Great Village, occupying an extension of the Annapolis Valley Triassic sandstone, shows a decided affinity with the valley fauna, but also has conspicuous elements of its own rarely, if ever, occurring elsewhere in the province. *Acronicta vinnula*, *Homohadena badistriga*, *Fishea enthea*, *Abrostola urentis*, *Peridea basitriens*, *Heterocampa bilineata* and *Oporophtera bruceata* are characteristic species of that district (Truro, Debert, Glenholme, Great Village). Just what special relationship these species may have to the flora there is not well understood, although at least two of them feed on the elm.

The fauna occupying the Carboniferous areas of Cumberland and Pictou counties also shows noticeable differences from that occurring in other parts of the province, but whether this is due to a characteristic vegetation, or merely to position relative to the adjacent and similarly Carboniferous areas of New Brunswick, is still something that can only be guessed at. Both factors are probably involved. The presence in this area of *Boloria titania grandis*, *Semiothisa perplexa*, *Semiothisa bicolorata* and *Itame loricaria* does suggest the fauna of northern and eastern New Brunswick.

Cape Breton Island, by its separation from the rest of Nova Scotia by the Strait of Canso, is doubly isolated, and in some aspects the lepidopterous fauna differs accordingly. In its flora, much of the island closely resembles the rest of northern Nova Scotia, with spruce, fir and larch as the dominant conifers, and deciduous forests composed of birch, maple, aspen, beech and balsam poplar (not on the mainland). The mountains and plateaus of Cape Breton Highlands National Park support many distinctly northern plants rarely found

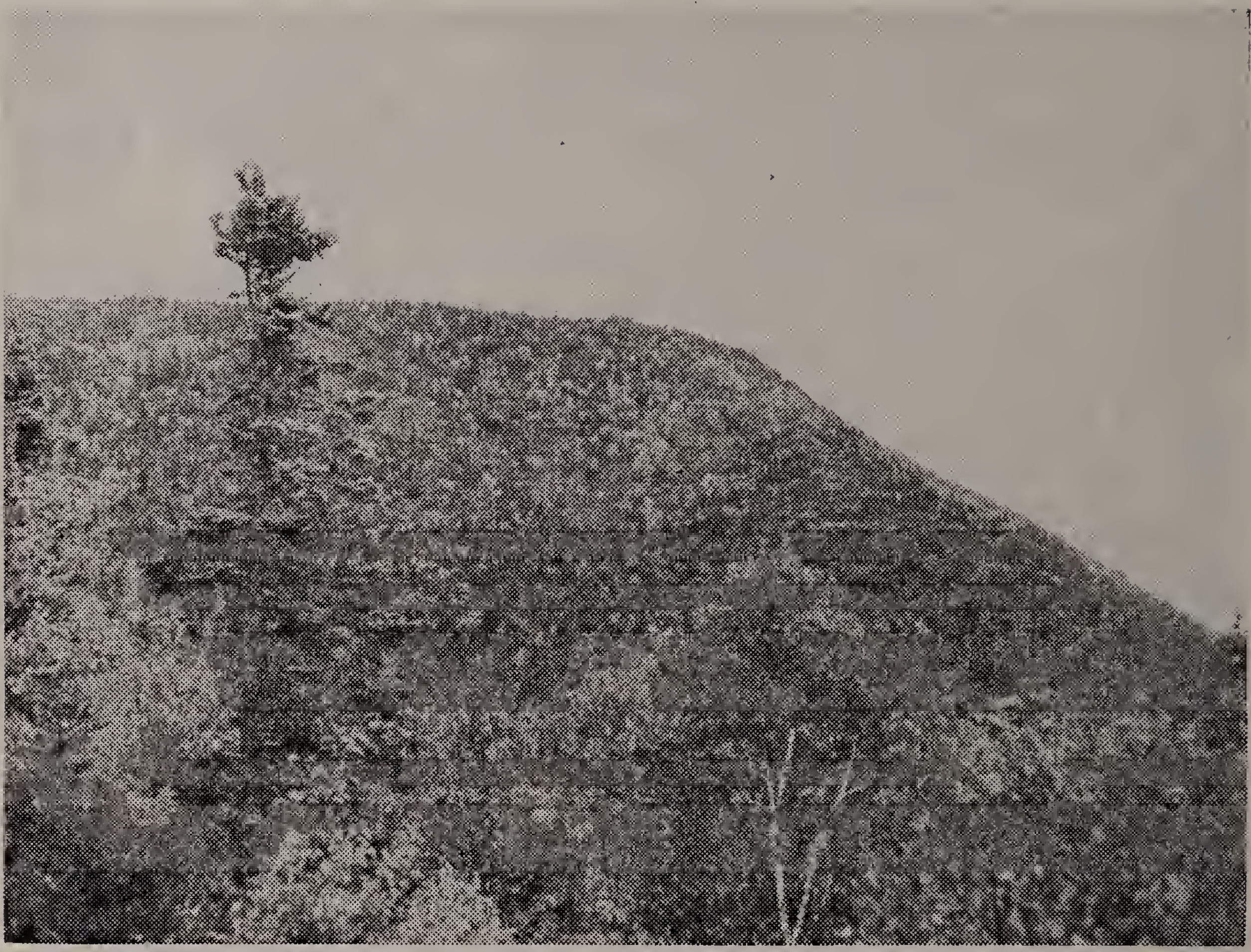


Figure 2. South side of Cape Smoky, Victoria Co., showing the characteristic ruggedness of the northern Cape Breton Island terrain.

elsewhere in this province, and this may indicate the presence of more truly boreal Lepidoptera than have so far been recorded; perhaps such species as *Anomogyna homogena*, *A. speciosa*, *A. sincera*, *Diarsia pseudorosaria*, *Syngrapha montana*, *Dysstroma truncata* and *Xanthorhoe algidata* will be found inhabiting the spruce forest atop French Mountain or North Mountain. Since the development of the National Park these localities have become somewhat more accessible than formerly, but have not yet received the entomological attention they deserve.

Habitats and Their Indigenous Species

These varied conditions provide a diversity of habitats for the insect fauna. Species like *Incisalia niphon*, *Panthea pallescens*, *Lapara bombycoides*, *Caripeta piniata* and *Lambdina*

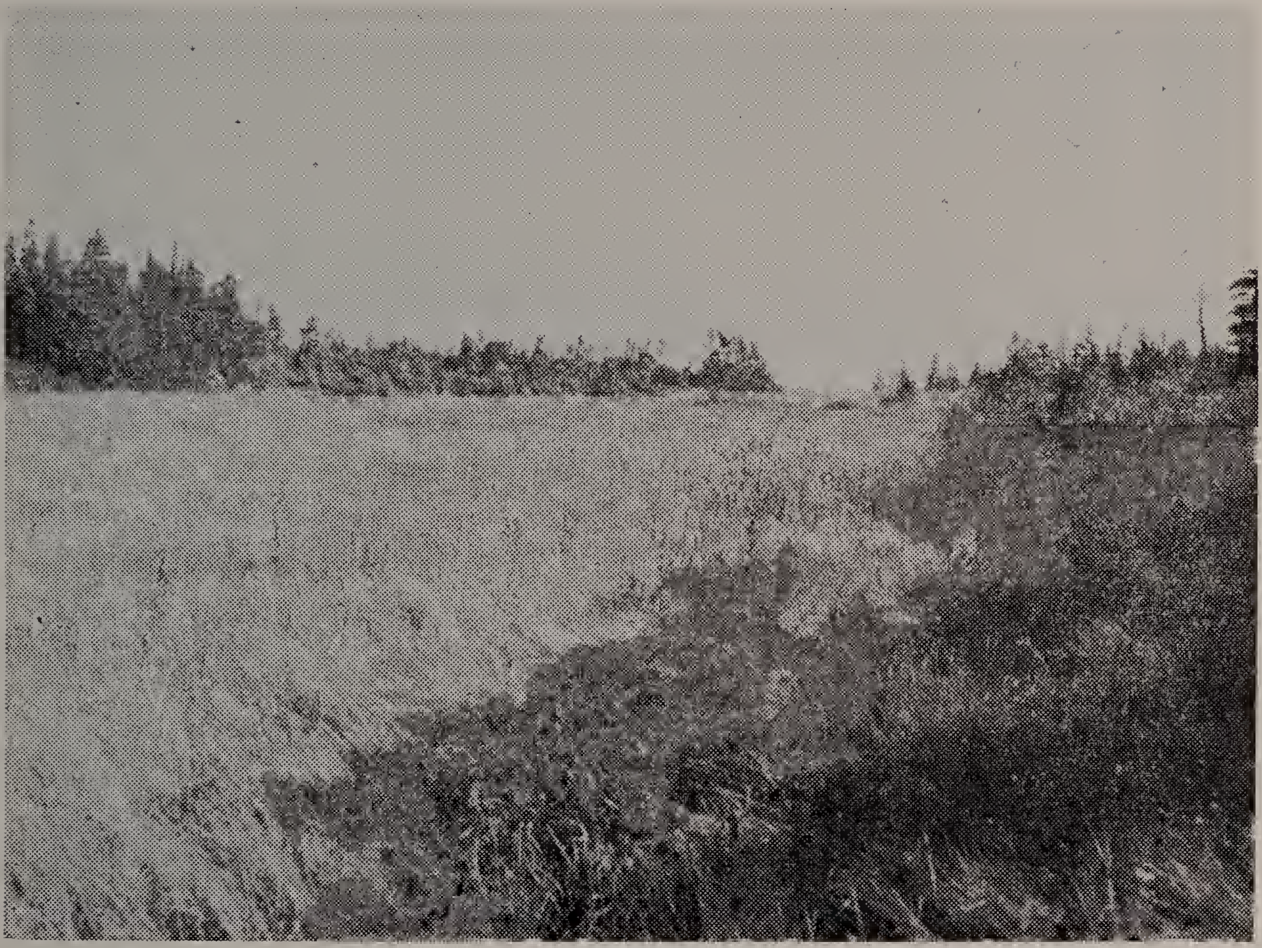


Figure 3. A grassy bog-meadow at 1400 feet, on the top of North Mountain, Inverness County.

athasaria, which inhabit the southern type of coniferous forest of pine and hemlock, do not normally extend northward into the forests of spruce and fir, except perhaps for a few which can transfer their attentions to *Pinus banksiana* in places where it grows. The spruce and fir woods have their own fauna that includes such species as *Panthea acronyctoides*, *Aplectoides condita*, *Anaplectoides pressus*, *Anomogyna perquiritata*, *Xanthorhoe abrasaria* and *Hydriomena frigidata*.

Oak woods, most noticeably around Annapolis, support a very characteristic group of species not quite duplicated under any other conditions. There are found *Erynnis juvenalis*, *Acronicta lithospila*, *Acronicta lobeliae*, *Lophodonta angulosa*, *Heterocampa umbrata* and *obliqua*, *Catocala ilia*, *connubialis* and *praeclara*.

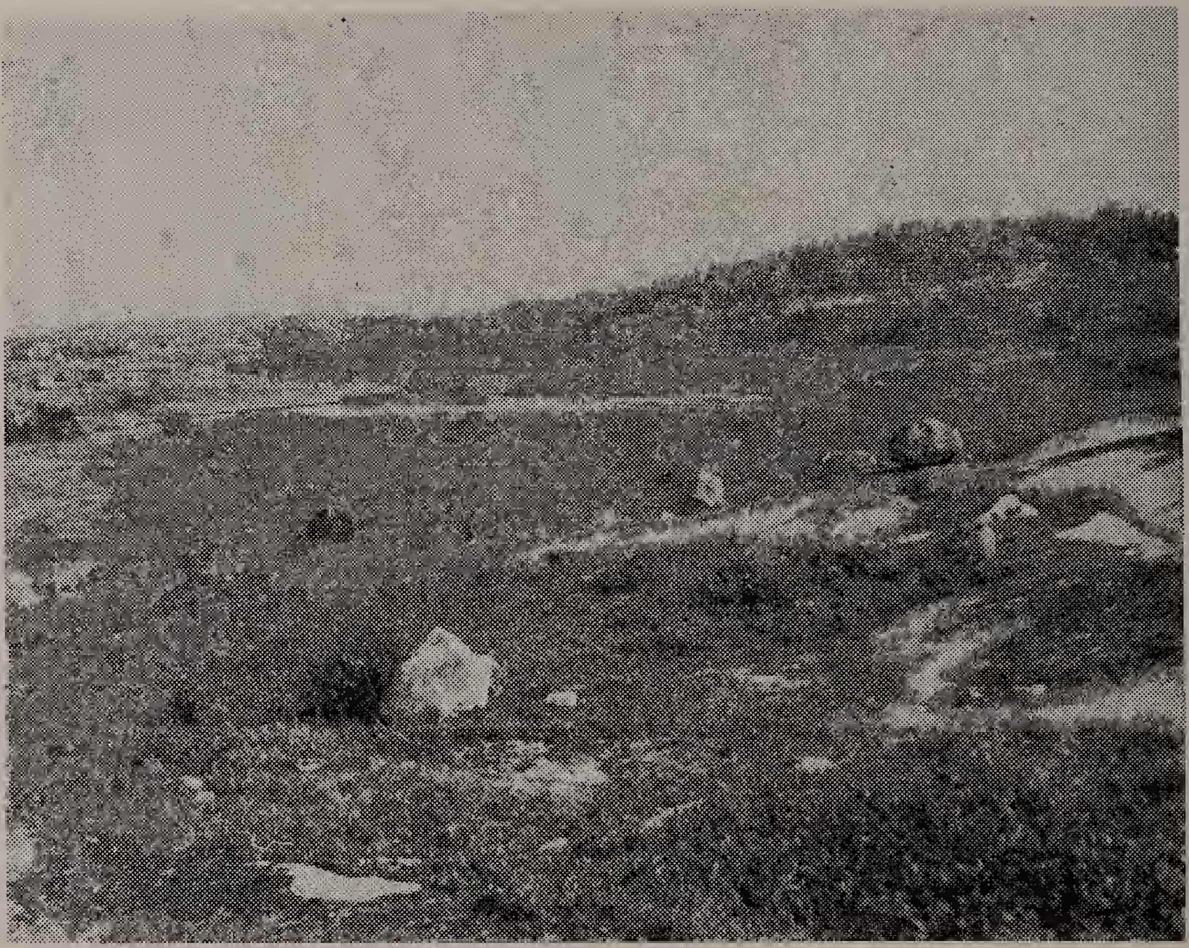


Figure 4. Looking across the barrens between West Dover and Peggy's Cove, Halifax County. This area yielded many interesting species.

Nova Scotia has no truly alpine conditions, but the presence of many cold, damp sphagnum bogs, as well as exposed, barren headlands along the coast, partly compensates for this deficiency. This close to sea level it is only in such locations as these that one may still see the last straggling remnants of a Pleistocene fauna that at one time flourished over much of the continent. On the Mount Uniacke bogs, in association with reindeer moss, crowberry, cloudberry, Labrador tea and other plants of an Arctic-alpine nature, there exists a very local but seemingly strong colony of *Anomogyna imperita*, which otherwise occurs in the east only in Labrador, northern Quebec and the high mountains of the Appalachians, around timber line. On these and other bogs fly *Anarta cordigera*, a *Lasionycta* sp., *Syngrapha microgramma*, *Carsia paludata*, *Eulype subhastata*, *Eupithecia gelidata*, *Oeneis jutta*, *Lycaeides argyrognomon*, and other distinctly northern species. A stretch of boggy black spruce forest near Parrsboro constitutes the southern-most locality for *Boloria titania* east of the Rocky Mountains.

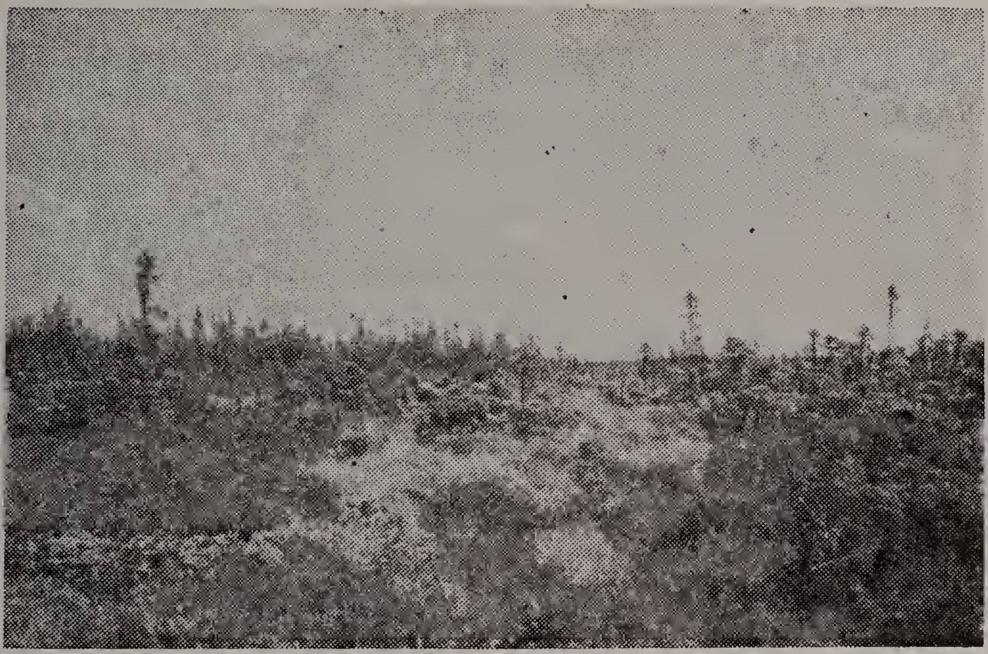


Figure 5. The bog habitat, near Mount Uniacke, of *Lycaeides empetri*, *Hemipachnobia Monochromatea*, *Carsia paludata* and many other species

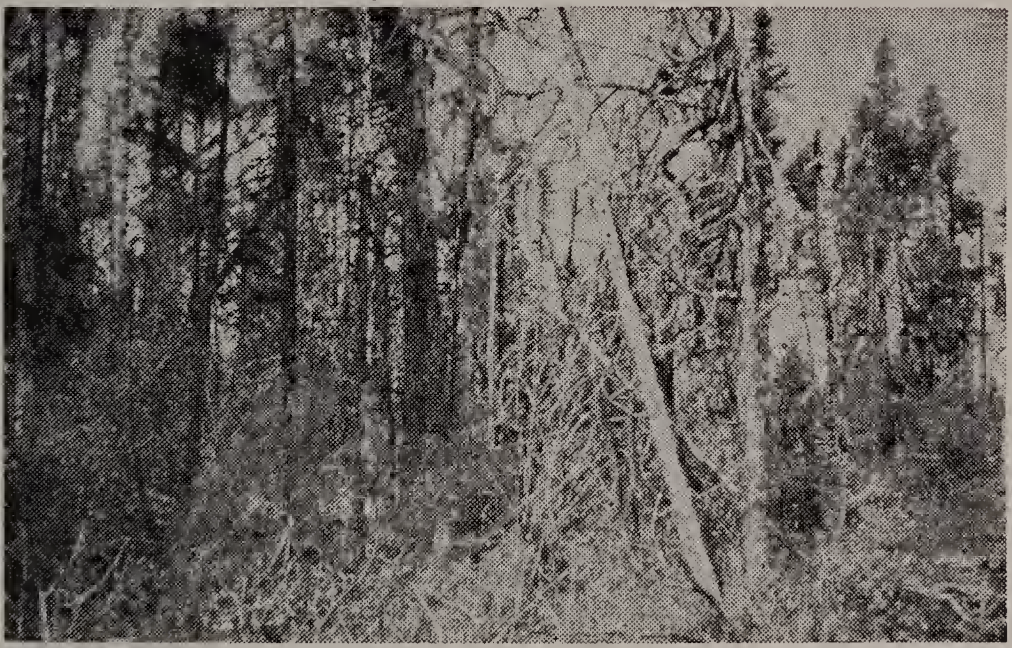


Figure 6. Haunt of *Oeneis jutta* in the tangle of half dead black spruces, at the edge of the same bog shown above.

It is not at all likely that all species indigenous to bogs and barrens have been derived from an arctic or subarctic fauna. Some are typical Canadian zone species that feed upon larch, cranberry, *Vaccinium*, *Myrica gale*, or some other bog or swamp plant. Among these would fall *Incisalia augustus*, *Hemipachnobia monochromatea*, *Oligia minuscula*, *Graphiphora oblata* and *opacifrons*, *Papaipema appassionata*, *Catocala coelebs*, *Epiglaea apiata*, *Itame sulphurea*, *Semiothisa oweni* and *sexmaculata*, *Glena cognataria*, *Metarranthis obfirmaria*, *Isturgia truncataria* and *Eufidonia discospilata*.

Some of the distinctly northern species are not confined to the bogs and barrens at all, but rather to the spruce and fir forests. These include *Anomogyna perquiritata*, *Xanthorhoe abrasaria* and *munitata*, and possibly *Caradrina quadrangula* and *Entephria aurata*.

The sea-shore and salt marshes harbour species rarely or never straying very far inland, such as *Ommatostola lintneri*, *Hypocoena orphnina*, *Spartiniphaga inops*, *Doryodes bistrialis* and *Papilio brevicauda*. Fresh water marshes and cat-tail swamps provide habitats for many other specialized species like *Ancyloxypha numitor*, *Bombycia algens*, *Hillia iris*, *Macronoctua onusta*, *Oligia diversicolor*, *Archanara oblonga* and *Hypocoena inquinata*.

The most completely isolated locality within our area is Sable Island, a twenty mile strip of sand over one hundred miles south-east of Cape Canso. It is treeless and covered only with coarse grasses, *Juniperus*, beach pea and other sea-shore plants. I have seen specimens of only one species from there—*Ommatostola lintneri*.

Although availability of a certain food plant seems to be the usual environmental factor responsible for the presence of a species, there are a few conspicuous cases where this reasoning does not hold. *Papilio brevicauda bretonensis*, our own endemic representative of the perplexing *machaon*

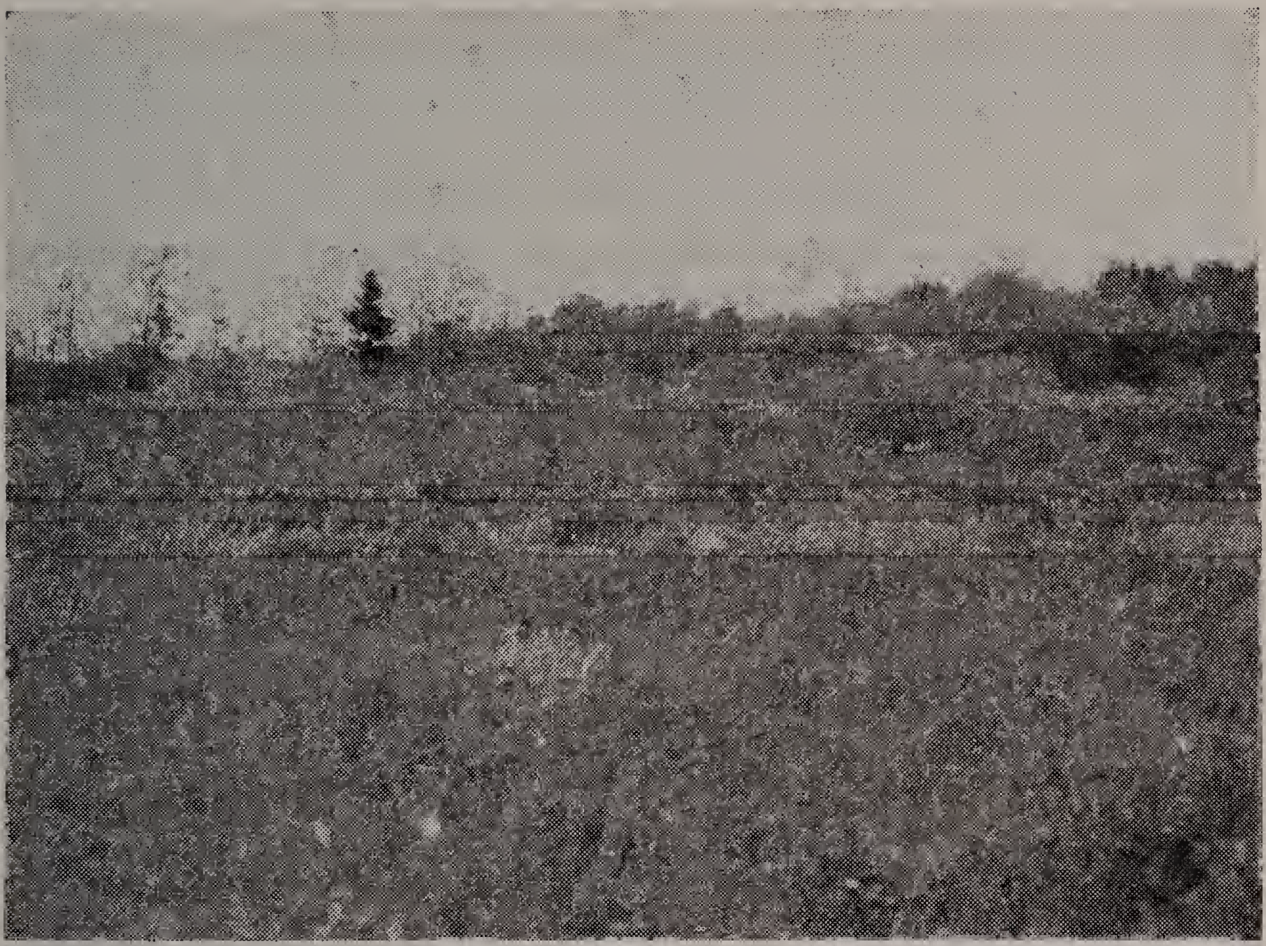


Figure 7. Marsh habitat of *Bombycia algens*, *Hillia iris*, *Oligia diversicolor* and *Macronoctua onusta*, near Aylesford, Kings County

complex, feeds upon Scotch lovage (*Ligusticum scothicum*) and occasionally on certain other coarse Umbelliferae. These plants are widely distributed, the lovage all around the coast from Cape North to the Bay of Fundy, yet *brevicauda* seems entirely restricted to Cape Breton Island, and even there is known only from the northern half. The species is not isolated geographically, since the adults are strong flyers that could readily cross the narrow Strait of Canso. So here may be detected the action of an environmental factor apart from food plant requirements or isolation. If it is climate influencing the organisms directly, then *brevicauda* must require a set of conditions held between relatively narrow limits, since the climate of Cape Breton Island, especially in the coastal zone where *brevicauda* occurs, does not differ too greatly from that of the adjacent mainland where the species is missing.

It is not a local butterfly in the sense that its colonies occupy the same locations year after year, but is continually shifting. It tends to die out completely in certain localities after flourishing there for several years, and then reappear elsewhere. This may perhaps be attributed to a depletion of the food supply, which is usually quite limited anyway, and also to a local build-up of the parasite population, *brevicauda* being subjected in that area to the depredations of a large parasitic wasp, *Trogus vulpinus* Grav.

On the salt marshes near Bathurst, N. B. occur *Lycaena dorcas dosPassosi* and *Coenonympha inornata nipisiquit*, and although the same marsh conditions prevail in Nova Scotia, the butterflies are absent. *Incisalia lanoraiensis* feeds on black spruce in the bogs of Quebec, Maine and New Brunswick, yet under identical conditions in Nova Scotia it too seems absent.

In a fully glaciated peninsular area like Nova Scotia, one might theoretically expect a rather full complement of northern species, and any gaps in the fauna to be mainly among species of a more southern character that had just not managed to push their way in during the long postglacial period. In reality, the northern species *are* many, but just as many more that might readily occupy this region have failed to appear. Southern species are surprisingly well represented, and since these are chiefly confined to the southern section between the Atlantic and the Bay of Fundy, it looks as though their ancestors must have crossed many miles of open water to get there. Many species, of course, would readily do this, and therefore their presence is not quite as perplexing as the existence in the same area of various similarly southern plants. Perhaps at some period a variation in climate allowed an infiltration of these more southern forms through the Isthmus of Chignecto. Then, in succeeding generations, these populations may have found the extreme south-western corner of the peninsula most to their liking, taken up their abode there, and abandoned the northern isthmus and adjacent areas through which they entered. Evidence so far points out the following as members of a group that followed some such pattern:

Celama triquetrana
Acronicta afflicta
Acronicta lobeliae
Leucania pseudargyria
Adita chionanthi
Morrisonia confusa
Psaphida grotei
Fagitana littera
Cerma cora
Amoleta fessa
Schinia nundina
Cryphia pervertens
Paectes oculatrix
Marathyssa inficita
Pseudeva purpurigera
Catocala coccinata
Catocala connubialis
Catocala subnata
Epizeuxis laurenti
Scopula cacuminaria
Hydriomena transfigurata
Semiothisa gnophosaria
Metarranthis lateritiaria
Plagodis kuetzingi

Some of the more southern species that have turned up are, of course, those known to have strong migratory or at least wandering tendencies, like *Colias eurytheme*, *Eurema lisa*, *Herse cingulata*, *Pholus fasciatus*, *Pholus satellitia pandorus*, *Feltia annexa*, *Alabama argillacea* and *Camptogramma stellata*. Of these, only *pandorus* is known to have survived the winter here.

A few species are suggestive of the fauna of western North America, and in general are much more common and widespread there than in the east. These are mostly species of the northern spruce belt stretching from the Atlantic to the Pacific, and here in the east tend to extend their range southward near the coast in the Acadian forest region. I would refer the following species to this group:

Boloria titania
Polygonia satyrus
Plebeius saepiolus
Euxoa tristicula
Diarsia pseudorosaria
Graphiphora oblata
Polia ingravis
Septis plutonia
Autographa flagellum
Lygris destinata
Plemyria georgii
Eupithecia nimbicolor
Eupithecia ravocostaliata
Hydriomena furcata
Semiothisa perplexa
Itame andersoni
Hesperumia sulphuraria
Selenia alciphearia

A few, like *Apantesis williamsii* and *Dysstroma truncata*, are present in New Brunswick, but there is yet no evidence of their presence in Nova Scotia.

Europe has not contributed quite as much in Lepidoptera as in Coleoptera (For the Coleoptera, see W. J. Brown, Can. Ent., Vol. 82, pp. 197-205). *Oporophtera brumata* and *Thera juniperata*, both probably introduced accidentally, have become abundant. *Stilpnotia salicis* is also plentiful but seems to feed only on *Populus alba*. *Euproctis phaeorrhoea*, once a pest in the Annapolis Valley, is now very rare. *Lymantria dispar*, a serious pest introduced into New England, has not been reported from Nova Scotia.

A Note on Collecting Methods

A few comments on the various techniques found most useful for collecting moths in this region might prove interesting to the reader.

Bait. A variety of bait maixtures have been tried, all of them giving good results under the right conditions. The chief ingredients used were molasses, preferably blackstrap molasses, crude sugar, cooked apples, over-ripe bananas, fermented or otherwise spoiled jams and jellies. A mixture of molasses and mashed bananas, apples or other fruit, left to ferment in the sun for a day or so, has proven a highly satisfactory bait. The addition of ethyl alcohol, rum, stale beer or amyl acetate might help, but these do not seem to improve greatly upon the naturally fermented fruit. Patches of the bait mixture three or four inches square are applied with a small paint brush to tree trunks at dusk, and the moths collected with flashlight and cyanide jar after dark. Frequently moths just refuse to come to bait for no apparent reason. This situation varies with locality, and so far the underlying causes have defied comprehension. Certain areas nearly always provide good bait collecting, while others, differing in no obvious way, yield little or nothing.

Lights. The Coleman gasoline lantern is the standard light source used for the nocturnal collecting. These lanterns give brilliant illumination of up to five hundred candlepower and, unlike electric lights, may be conveniently carried into the woods and set up at suitable collecting sites anywhere. The lantern is supported at a height of four or five feet on a specially made iron rod support driven into the ground. About two feet behind the lantern hangs a white sheet from a rope tied horizontally between two trees. On barrens where there are no trees, the sheet is simply spread on the ground and the lantern supported about two feet above it. Many of the moths eventually come to rest on the sheet after flying about the light for a while, and are then easily bottled. It is often practical to operate three or four sheets and lanterns simultaneously by setting them up at intervals along an old wood road or on a bog, and tramping back and forth from light to light during the course of the evening.

Moths are strongly influenced by changes in temperature. Many species, especially early spring and late fall ones, will fly freely on cool nights when the temperature is in the forties, but should it drop even four or five degrees below where the mercury stood when they began flying, they may cease activity entirely. In warmer weather it takes a drop of about ten degrees to influence them noticeably. A drop from 65° to 55° F. will result in most species disappearing for the remainder of the night. Many mid-summer species will not fly at all at temperatures below 50°F. if they are accustomed to warmer weather.

Humidity also has some bearing on their activity. Summer nights in this region tending to be cool, periods of drought frequently provide the best collecting. Moths seem able to sustain their activity during a greater drop in temperature if the atmosphere is dry. They fly actively all night in very dry weather. Very damp nights, even with fog or heavy rain, may provide excellent collecting if it remains warm, perhaps about 60° or 65°F., but a combination of extreme dampness, even locally, such as ground fog, and a lowering temperature, constitutes a condition that few species will endure. Several lights differently situated can give striking evidence of this. A lantern placed in a bog on a still, cool night may attract absolutely nothing, while another situated on an adjacent hillside, perhaps forty or fifty feet higher, just above the layer of low lying damp air, provides very good collecting.

Moths do not come readily to light when there is a bright moon, and on a clear night when the moon is about full most of them will ignore a lantern altogether. During that part of the month when the moon is not visible in the evening, moths come to light commonly, sometimes even in swarms. It is probably just a matter of competition between the light of the moon and that of the Coleman lanterns.

The Net. Some species of moths have diurnal habits, and are best taken with a butterfly net. Such species as *Mesothea incertata*, *Eufidonia discospilata*, *Isturgia truncataria*, *Metarranthis obfirmaria*, *Bapta semiclarata*, *Eubaphe lamae* and *Syngrapha microgramma* are in this class. Many bog species are diurnal, perhaps because the cold, damp conditions prevailing at night inhibit nocturnal activity. This is one of the major ways in which bogs approximate arctic or alpine conditions.

Collecting larvae. In addition to the usual methods of sweeping and beating for larvae, another highly successful method was found, rather accidentally. This consists of searching the leaves and branches at night with a strong light. Many larvae hide during the day and feed at night; they are then conspicuous. This seems particularly true of the *Catocaline* species. At Lequille, Annapolis County it was possible, by nocturnal searching, to find scores of *Synedoida grandirena* caterpillars feeding on and crawling over *Hamamelis* bushes, where not one could be found during daylight hours. A similar situation was also found later at Lake Rossignol. Many species of larvae have been collected in this way.

Statistics

The present catalogue is based on over fifty thousand collected specimens of Macrolepidoptera. Of these, perhaps seventy-five per cent have been taken during the past eleven years by the author. It records the occurrence of sixty-eight species of butterflies, and about seven hundred and sixty-four species of moths, or a total of eight hundred and thirty-two distinct species, approximately sixteen per cent of the total number of species occurring in Canada and the United States. The Perrin and Russell catalogue, together with the additions, listed five hundred and three separate species, so the present work mentions the occurrence of three hundred and twenty-nine species not hitherto reported from Nova Scotia in a list of this kind, although scattered references to a very few of them have been made in descriptive and revisional papers of other authors. Of the species listed, there are fifty-seven, or less than seven per cent, that the writer has not personally encountered, but in most cases he has seen the specimens upon which the records are based, and can safely vouch for their authenticity.

SUMMARY

This is the ninth list or catalogue dealing entirely or in large part with the Lepidoptera of Nova Scotia, although the last one appeared thirty-eight years ago. Lepidopterists who have already made important contributions to a knowledge of the area are or were: J. H. McDunnough, Joseph Perrin, John Russell, H. G. Payne, and Arthur D. Hall.

The more central portions of Nova Scotia have received more attention from lepidopterists. A few extensive districts, more difficult of access, still remain relatively unexplored.

Peninsular and insular Nova Scotia has a truly temperate climate, with mild winters and abundant rainfall. The southern half of the province is mostly granite, quartzite and

slate, the northern half sandstone, shale and conglomerate. The flora is that of the Acadian forest region, a mingling of Alleghenian, Canadian and Hudsonian elements. The Annapolis Valley, parts of Colchester, Cumberland and Pictou counties and Cape Breton Island each have special combinations of lepidopterous species differing from those of the large hard rock area to the south. These local differences at least partly agree with the geological pattern.

Nova Scotia provides a variety of habitats; viz., southern oak-pine-hemlock woods, northern hardwood forest, northern spruce forest, sandy pine barrens, bogs, sea-shore barrens, salt marshes. As well as the expected Canadian zone species, a few surprisingly northern and southern ones are also present, also some reminiscent of the west.

Collecting moths with baits, lights (especially gasoline lanterns), nets and as larvae have all been successful under local conditions.

This catalogue, based on over fifty thousand specimens, reports eight hundred and thirty-two species, three hundred and twenty-nine more than were recorded in the last published list.

EXPLANATIONS

In general, the nomenclature and arrangement employed follows Dr. McDunnough's Check List of 1938. Important changes since brought about by revisions of groups and by various other taxonomic papers that have since appeared are, however, incorporated. In a few instances changes have been made to conform with my own views, more or less in anticipation of such changes being inevitable in the light of information not previously available. The individual species that have, since 1938, been described, resurrected or discovered but not yet described are inserted, on the basis of relationship, in what would seem to be their appropriate positions.

When a species has been taken repeatedly in many different localities, a generalized statement is made explaining its distribution, such as, "generally distributed". Otherwise the localities are separately listed. When a number of specimens have been taken, the earliest and latest dates of capture are given, and if a species has more than one generation a season, the earliest and latest dates are given for each brood.

All readily available information on larval food plants has been included, with the hope that this might make the work more useful to other lepidopterists. In cases where I have personally bred a species from the egg or larva, on a known plant, and can therefore fully vouch for the reliability of the information, this is clearly indicated. When the host plant information is based on the experience of others due acknowledgement is made or, if the early stages are more generally known, such expressions as "larva on spruce" are commonly employed. Definite statements are made only when there is virtually no doubt as to their reliability. Wherever there is even slight reason for doubt, it is clearly suggested by the wording.

Much time and effort has been spent on the determination of the species, and I feel that a fair degree of accuracy has been achieved. Nova Scotian material in some of the more difficult groups has been the subject of exhaustive study, which necessitated the making of numerous genitalic slides, repeated reference to what literature has been available, and the rearing of larvae when this has been possible. The work of identification, though satisfactorily terminated for the bulk of the species listed, still shows many points of weakness. This is inevitable in a group as large as the Lepidoptera, and especially so in an area as little known entomologically as the Maritimes. Those cases of the species being given only tentative determinations are usually due to one or more of the following factors:

(1) The species being rare and poorly known, often involved in a difficult group, and insufficient material available for the ascertainment of its proper status (e.g., *Fishea*, *Mniotype*).

(2) Species, although sometimes common enough, belonging to a very confusing genus. In many cases the larvae must be seen to make determination positive (e.g., *Datana*, *Cerura*, *Dasychira*).

(3) Published literature unsatisfactory for determination purposes and the types unavailable.

ACKNOWLEDGEMENTS

To Dr. James H. McDunnough, who personally worked up, with painstaking thoroughness, the *Eupithecias*, *Hydriomenas* and *Euxoas* upon which my records are based, who has verified or refuted many of my own determinations and who has, during the past nine years, answered innumerable questions involving almost every group, I am profoundly grateful.

Sincere thanks are also due Drs. George P. Holland, T. N. Freeman and Eugene G. Munroe of the Unit of Systematic Entomology, Department of Agriculture, Ottawa for lending material from the Canadian National Collection and supplying photographs of the McDunnough and Freeman types collected in this area. I owe similar indebtedness to Mr. John G. Franclemont, formerly of the United States National Museum but now of the Department of Entomology, Cornell University, for his kindness in lending material for study, answering questions and rendering opinions on various problems in the *Phalaenidae*. Special acknowledgement must also go to Dr. Frederick H. Rindge of the American Museum of Natural History for the loan of material from that institution, thus also aiding the process of determination in certain Phalaenid genera, and to Mr. Laurence R. Rupert of Sardinia, New York, my congenial companion of several collecting trips in New England and the Maritimes, who has been a reliable source of much information, especially on taxonomy and larval habits of the Geometrid sub-family *Ennominae*. I must also thank Mr. Otto Buchholz, Roselle Park, New Jersey, who rendered valuable aid by straightening out our material in the very difficult *clarescens* group of the genus *Acronicta* and assisted with the determinations in *Datana*, and Dr.

A. E. Brower, Augusta, Maine, whose knowledge of the fauna of Maine has been placed willingly at my disposal.

Without the valuable assistance provided, directly and indirectly, by these and other lepidopterists, my catalogue would surely have fallen far short of the mark in completeness and reliability.

Superfamily PAPILIONOIDEA

PAPILIONIDAE

Papilio L.

4 *P. ajax* L. (*P. polyxenes asterius* Cram.) Black Swallowtail.

The present distribution of the black swallowtail probably includes all of Nova Scotia. The species has been taken from Cape North, Ingonish and Baddeck, south to Digby, and in most of the intervening counties. In the north-west it occurs in Cumberland County, and flies very commonly just across the border near Sackville, N. B. June 17-August 31. Stragglers of the first brood are still flying when the second brood begins to appear about July 23 (Halifax and Kings counties). On Cape Breton Island only a small percentage of the pupae seem to emerge as a second brood, but on the mainland farther south late summer individuals are so numerous in some localities as to indicate that a full second brood appears. *Ajax* is apparently a very general feeder on Umbelliferae; larvae on *Ligusticum*, *Heracleum*, *Daucus*, Carroway and Parsley.

There is evidence suggesting that *P. ajax* is a relatively recent arrival in this area. The earliest known record was a specimen taken on MacNab's Island, August 15, 1925 (Perrin). The intensive collecting of diurnals carried on earlier in the century should certainly have yielded as conspicuous a butterfly as *ajax* had it been present. Since this is a butterfly of open field and meadows, it seems logical to think that it was originally confined to more southern or central portions of the continent, before the heavily timbered north-east was opened up by man.

5b *P. brevicauda bretonensis* McD. Plate I, Figure 1.

McDunnough, Can. Ent., Vol. 71, p. 153.
Ferguson, Lepidopterist's News, Vol. IV, p. 11.

This race of *brevicauda*, described from Kidston Island in the Bras d'Or Lakes opposite Baddeck, seems confined to the northern half of

Cape Breton Island. Quantities of larvae have been collected and reared from the type locality and several other spots on the shores of Baddeck Bay, Terre Noire, Inverness County, Dingwall and at Eel Cove on St. Ann Bay, Victoria County. Adults were found flying at Terre Noire, July 2 and 6, 1949, and near Cheticamp and Cap Rouge, July 3, 1949. Dr. McDunnough took a female on Kidston Island July 12, 1936. Of the several hundred larvae of *bretonensis* that have been collected, all were feeding on *Ligusticum scothicum* except a few from Dingwall, which were on another coarse Umbel, possibly *Coelopleurum.* Nearly all the larvae pupated by the first week of August, and none emerged as a second brood. Of over two hundred and fifteen larvae that I collected, all but two or three were of a pale green form with yellow spots, not so broadly banded with black nor bearing orange spots like most *ajax* larvae in this region. Apparently dark *brevicauda* larvae do occasionally appear. Although the ranges of the two species overlap in Cape Breton, and in some instances larvae of both have been found on the same clump of plants, there is no evidence of interbreeding.

This butterfly is to be looked for on Cape Breton Island wherever *Ligusticum* grows, but the populations fluctuate greatly from one season to another. It was evidently common in the Baddeck area in 1936 and 1938, yet repeated efforts to find it there between 1943 and 1948 failed entirely. Not till 1949 was its reoccurrence on Baddeck Bay noticed.

12 *P. cresphontes* Cram. Giant Swallowtail.

There is a single record of the occurrence of *cresphontes* in Nova Scotia, at Lakeview, near Windsor Junction, Halifax County, probably in August, 1901 (Miss Helen King). The specimen, in the collection of the Nova Scotia Museum of Science, is a very tattered male. Although its condition implies that it might actually have strayed here, the presence of railway sidings at Windsor Junction suggests another possibility. The larvae prefer Rutaceae, especially orange trees but are reported from many other plants, including prickly ash and Lombardy poplar.

15a *P. glaucus canadensis* R. & J. Northern Tiger Swallowtail.

This forest dwelling species occurs throughout Nova Scotia. It is our commonest *Papilio.* I have taken or observed it in numerous localities in almost every county from Digby north-eastward to Baddeck. Strictly single brooded, *canadensis* flies from May 24 to mid-July, with a peak of abundance around the middle of June. At Three Brooks, Pictou County and Lequille, Annapolis County I have seen it feeding in enormous numbers, mostly males, on lilac blossoms in country gardens. Bred from Larvae on cherry, apple, ash, poplar, willow and alder.

PIERIDAE

Colias Fabr.

41 *C. eurytheme* Bdv. Orange Sulphur.

Sporadic in its occurrence and apparently unable to survive the winter. The population of *eurytheme* seems to depend for its annual replenishment on migrant females arriving from farther south in June and July, and some years these do not appear at all. Occasional large, and usually badly worn, females are seen in spring and early summer, and ova secured from one of these at Armdale, July 13, 1943 were reared and produced adults in August. Most captures of *eurytheme* have been made in Halifax County, where it has been seen northward to the Musquodoboit Valley. A few were seen around Annapolis Royal in 1946 and one was taken there September 12. Dates for late summer range from August 19 to October 16, suggesting more than one native generation. Larvae feed on clover and alfalfa.

As with *P. ajax*, there is evidence that *eurytheme* made its first appearance in Nova Scotia during this century. It remained unreported until September 4, 1910, when Joseph Perrin took a female on MacNab's Island. On September 12, 1913 he captured a male. Since then it has reoccurred many times about Halifax, sometimes outnumbering *C. philodice.*

42 *C. philodice* Godt. Clouded Sulphur.

Generally distributed, including Cape Breton, and very common. Two and possibly a partial third brood, May 15 - October 16 without a noticeable break, although steadily increasing in abundance towards the end of the summer. Stragglers seen some seasons as late as the first week of November. Only one or two white females of the spring brood taken, but up to twenty-five per cent of the late summer females may be of this form. The chief larval food is probably clover.

45a *C. interior laurentina* Scud. Pink-edged Sulphur.

Common in numerous localities from Barrington Passage to northern Cape Breton; no doubt present on suitable bogs and blueberry barrens throughout the area. June 11 - August 18. Single brooded. Host plant supposed to be *Vaccinium.* A few of the females, probably not more than ten per cent, are of the white form, and a higher percentage are intermediate between the white and yellow forms.

Laurentina, described from Cape Breton Island. (Scudder, Proc. Bost. Soc. Nat. Hist., XVIII, 189-190, 1876), differs from typical *interior* from north and west of the Great Lakes in its slightly smaller size and broader black border. The types, collected by Thaxter, were deposited in the Museum of Comparative Zoology, Cambridge, Mass.

Eurema Hbn.

72 *E. lisa* Bvd. & LeC.

A rare migrant. MacNab's Island, August 24, 1904, September 1, 1912; Digby, August, 1904; Little Narrows, Baddeck, July 14, 1938 (T. N. Freeman); one seen in downtown Halifax, August, 1945 (Ferguson). Nearly all were of the pale form. Food plants; *Cassia*, *Amphicarpa*, clover.

Pieris Schrank

83d *P. napi oleracea* Harr.

Seemingly diminishing in numbers and occupying only a part of its former range. Halifax, Fall River, Truro and Baddeck, June 2 - July 18; second generation "*cruciferarum*", July 21 - September. Not found in Halifax County since 1933, except for one worn male I took within the city limits near Armdale, September 12, 1942. Still common in the vicinity of Baddeck, especially along the road up Beinn Breagh. The only second brood specimens from there were taken August 4, 1950. Plentiful along the main road at Mount Thom, Pictou Co,. June 16, 1953.

Mention is made of *napi* in all the earlier lists, indicating that it must have been quite common during the latter half of the last century. For example, in 1864, Thomas Belt wrote of the species, in listing the butterflies of the Halifax area: "Common. The first brood appears at the end of May; the second in July".

Larvae probably on *Dentaria* and other woodland Cruciferae.

86 *P. rapae* L. Cabbage Butterfly.

The earliest papers on Nova Scotian Lepidoptera, by Belt (1864) and Bethune (1869) make no mention of *Pieris rapae*. In 1870 J. M. Jones wrote of the species: "It was observed in Canada Proper some years ago, and has been making its way eastward rapidly, until about three years ago it first became known about Halifax." The Butterfly is now only too well known throughout Nova Scotia, and its feeding habits scarcely necessitate further mention. There are several broods flying from May 4 until October.

The Nova Scotia Museum of Science has three males of the rare yellow aberration "*novangliae*" of Scudder, all from MacNab's Island, June 7, 1923, June 7, 1924, June 24, 1927. Dr. J. A. Comstock figures a specimen on Plate 9 of the *Butterflies of California* from Smith's Cove, Digby County.

DANAIDAE

Danaus Kluk

89 *D. plexippus* L. The Monarch

Halifax area, May 27—June 19, and August 18—October 24. Also seen in early November. Parrsboro, Truro, Gay's River, Vogler's Cove, White Point Beach, Digby, Annapolis, May 26 into June, and July 28-September 30. Normally only a scattering of individuals appear, even in late summer, when they are seen feeding on blooms of *Centaurea* or *Solidago*; but the following note on a relatively large flight was given me by Mr. J. Lynton Martin, now of the Nova Scotia Museum of Science staff, regarding the appearance of the species at Vogler's Cove, Lunenburg County, in 1949:

"A few specimens of *Anosia plexippus* L. appeared in the Vogler's Cove area in late August and early September. In the course of a day's collecting one would capture one to three specimens, seldom more. No noticeable increase in numbers was noted until September 25th when twenty-five specimens were taken from a small clump of fall flowering weeds (Goldenrod, Aster, etc.) within a few yards of the door of the laboratory. Thirty-two specimens were taken in the same place on the 26th, sixty specimens on the 27th, seventy-five specimens on the 28th, thirty-five specimens on the 29th and nine specimens on the 30th. We considered this an odd occurrence for Lunenburg County, since, as a rule, this species is fairly rare, the average collector seldom expecting to capture more than a half dozen specimens during the season".

Although there is no record of *plexippus* breeding here, larvae should be looked for on *Apocynum*. The common milkweed, *Asclepias syriaca*, is not indigenous to Nova Scotia.

SATYRIDAE

Lethe Hbn.

96 *L. portlandia borealis* Clark. Pearly Eye.

Fall River and Miller's Lake, Hfx. County, Three Brooks, Pictou County Lake LaRose and South Milford, Annapolis County, Digby, Mount Uniacke. July 8 - 25. At Dorchester, N. B., as late as August 11. Never common. Usually occurs near moist, grassy places in woods and rests head downward on tree trunks. Larva on grasses.

106 *L. eurydice* Joh. Common Grass Nymph.

Common among the coarse grasses in marshy spots at Baddeck, near Pictou, East Hansford, Cumberland County, and other northern localities; scarcer southward. Occurs sparingly in suitable locations in Halifax County to the border of Hants County. No records for farther south and only one for the Annapolis Valley region at Aylesford. July 6 - August 7. Larva probably on coarse marsh grasses.

Euptychia Hbn.

(103) *E. cymela* Cram. Little Wood Satyr.

Several taken at Dartmouth, probably in June, 1946 (David Gray). Apparently very local.

Minois Hbn.

117 *M. alope* Fabr. Wood Nymph, Grayling.

All of Nova Scotia seems to lie within a zone of transition between *alope*, or perhaps the coastal New England race *maritima* Edw., and race *nephele* Kby. This zone continues up the north-eastern coast of New Brunswick at least to Bathurst. The species is common about hay fields and grassy locations everywhere. At Annapolis, almost fifty per cent have the yellow band of *alope*, the rest are very dark *nephele*, or intermediate. In Pictou and Cumberland counties yellow banded specimens still form a conspicuous, though smaller, percentage of the population, but at Baddeck scarcely one in ten has a well defined yellow band. The assumption that this tendency towards yellow banded individuals decreases northward does not entirely hold, since they seemed plentiful at Bathurst, N. B., August 2, 3, 1949. Dates for Nova Scotia—July 9 - August 24, with a peak of abundance in late July. A few very worn specimens survive into September. Larva on grasses.

Oeneis Hbn.

130 *O. jutta ridingiana* Cherm. & Cherm. Jutta Arctic.

I first took *jutta* in 1946 on two bogs near Mount Uniacke, where it has since been observed annually. Otherwise seen only on French Mountain, Inverness County, despite extensive searching of other bogs. June 3-23. *Jutta* prefers little open sunny glades among the black spruces in wet locations bordering the bogs, and is exceedingly difficult to capture, alighting on lichen covered tree trunks, stumps, or on tangles of dead spruce branches. The best time to collect it is early morning when the butterflies are sunning themselves, but it is still too cool for much activity. The species is extremely local, by no means occurring in all suitable looking locations along the bog margins where one would expect it. Scudder reared it on lawn grass, but certain bog sedges or grasses constitute its favoured food under normal environmental conditions. Mr. D. J. Lennox successfully reared *jutta* on a species of cotton grass (*Eriophorum*) in New Hampshire.

The source and disposition of the material employed by Holland as a basis for his common name, the "Nova Scotian Arctic", remains a mystery.

NYMPHALIDAE

Speyeria Scud.

166a *S. cybele novascotiae* McD. Great Spangled Fritillary. Plate I, Figure 2.

McDunnough, Can. Ent., Vol. 67, pp. 18-19, 1935. Type locality: White Point Beach, Queens County.

This race is characterized by "a distinct encroachment of red-brown into the yellow submarginal band of the underside of the secondaries". In size it averages rather small. The earlier lepidopterists invariably confused it with *aphrodite.*

Generally distributed, but scarcer in Cape Breton, being greatly outnumbered there by *atlantis.* Very plentiful on the mainland and especially so in the southern countries, usually, like others of the genus, on flowers of *Centaurea, Aralia* and thistle. June 24 - September 10. *Speyeria* larvae are thought to feed on violets, but are notoriously hard to find. A full grown one found crawling on a sandy road at Aldershot, June 3, 1951, pupated without further feeding on June 7, and produced a male of this species on June 25.

167e *S. aphrodite winni* Gunder.

Generally scarcer and more local than the preceding species, but common around Parrsboro, Bridgewater, New Germany and Cherryfield, Lunenburg County, and Centreville, Kings County. Also from other localities in these counties, as well as Digby, Annapolis, Halifax, Colchester, Pictou, Antigonish, and at Baddeck, Victoria County and Lake Ainslie, Inverness County. Always commonest in rich, moist meadows of river valleys and intervales. July 17 - August 20.

171 *S. atlantis* Edw. Mountain Silver-spot

Usually the most plentiful *Speyeria* everywhere, even more general than *novascotiae* and similarly unrestricted in habitat. June 7 - September 7.

Boloria Moore

200a *B. selene atrocostalis* Huard. Pearl-bordered Fritillary.

Present in moist meadows and sheltered marshy areas throughout. Two broods: June 2 - July 25, and July 27 - September 4.

Two unusual variants were taken at Fall River, Halifax County by Perrin, June 14, 1904 and June 2, 1921. One of these has most of the spots in the median area and near the base fused together, forming a broad black median band; the other is the reverse, with the marginal and submarginal spots fused forming a broad black border on the outer margin, and the median row of spots greatly exaggerated on the secondaries. Larva supposedly feeds on violets.

206b *B. titania grandis* B. & McD. Plate I, Figures 3 and 4.

A small colony of this northern species still survives in a tract of boggy spruce forest near Parrsboro, on highway Route 9 to Advocate Harbour. Dr. McDunnough took a female on the West Bay Road, Parrsboro, August 23, 1943, and for a time it remained a mystery where this specimen came from. In early August, 1949, I located a flourishing colony in a belt of black spruce and jack pine forest between Dorchester and Sackville, N. B., and on August 12 of the same season took two males in a somewhat similar environment in the above mentioned area near Parrsboro. In New Brunswick the species flies at its best during the first week of August, feeding on blooms of *Solidago* and *Spiraea*. At Nordegg, Alta., Dr. McDunnough found a larva on willow, and also a pupa attached to a willow twig.

Euphydryas Scud.

217a *E. phaeton borealis* Cherm. Baltimore Checker-spot.

Rare and very local. Truro, Onslow and Londonderry Mines, Colchester County, Bedford, Fall River and Preston, Halifax County, Baddeck, Victoria County June 20 - August 12, mostly in mid-July. I took six in a meadow along a watercourse at Londonderry Mines, July 18, 1948, and one other specimen there July 18, 1950. It occurs along a narrow secondary road a mile or so in back of Baddeck (McDunnough and Freeman). Larva on *Chelone glabra*.

Melitea Fabr.

256a *M. harrisii albimontana* Avin. Harris' Checker-spot.

Local in suitable locations, never abundant. Taken from Digby and Queens counties northward and eastward to Baddeck. One brood, June 14 - July 19. Bred from hibernated larvae found on *Aster umbellatus* in late May and early June.

263 *M. nycteis* Dbldy. & Hew. The Silver Crescent.

Between June 22 and 28, 1934, Dr. McDunnough captured five specimens of *nycteis* along a roadside at South Milford, Annapolis County. I took four others at the very same place, June 27 and 28, 1951. Apparently no other records. Food plants: *Helianthus, Aster.*

Phyciodes Hbn.

265a *P. tharos arctica* dosP. The Pearl Crescent.

The description of this race from Newfoundland fits most of the Nova Scotian population almost equally well (see McDunnough, Can. Ent. Vol. 67, p. 211, 1935). Common everywhere, including Cheticamp, Cape North and Ingonish, Cape Breton, where they perhaps most closely approach typical *arctica*. June 12 - August 11, with sometimes a partial second generation in the fall; Three Brooks, Pictou County, Sept. 7; Wolfville, fresh specimens plentiful September 2, 1951. Colonies of the young larvae conspicuous on *Aster umbellatus* in late summer.

Polygonia Hbn.

285 *P. interrogationis* Fabr. Question Mark, Violet Tip.

MacNab's Island, Halifax, Armdale and Miller's Lake, Halifax County, Debert, Colchester County, Three Brooks, Pictou County, Baddeck, Digby. July 1 - August 22. Not common. A dwarfed second brood specimen (evidently) of this form with dark secondaries on September 10, 1945 at Halifax.

The autumn, hibernating form "*fabricii*" Edw., at Halifax, MacNab's Island, Armdale and Ragged Lake, Halifax County, Debert and Great Village, Colchester County, Digby, Wolfville. August 12 - September 26. Commoner than the summer form. Bred from larvae on *Humulus* at Wolfville, where they were almost in sufficient numbers to defoliate the vines, and on elm at Great Village.

287 *P. satyrus* Edw. Satyr Angle Wing.

Very rare, though like the other *Polygonias*, once considerably commoner than now. Digby, August 6-25, 1905-06, a good series; Armdale, April 20, 1920, May 18, 1943; Ragged Lake, Halifax County, July 24, 1922; Sydney, three specimens taken about 1900 (Miss M. Brown). Old specimens without date also seen from Windsor. Larvae on nettle in British Columbia.

288 *P. faunus* Edw. Green Comma.

Digby, Armdale, MacNab's Island, Fall River, Truro, Stellarton, Springhill Junction, August 9 - September 3, and April 4 - May 9. Most recently at Springhill Junction, Cumberland County, August 10, 1949. Food plants; birch, alder, willow, *Ribes*.

292 *P. gracilis* G. & R. Hoary Comma.

Truro, August 26, 1927 (in the Canadian National Collection), and Stellarton, no date (C. B. Hills). Rarest of the recorded *Polygonias*. It is moderately common near Bartibog, north-eastern New Brunswick in early August, where the butterflies may be found on flowers of *Solidago*, pearl everlasting, or sunning themselves on bare ground, in company with *faunus* and *progne*.

294 *P. progne* Cram. Gray Comma.

Certainly no longer common, as recorded by earlier collectors, but still the most generally distributed of our *Polygonias*, occurring in the counties of Digby, Annapolis, Halifax, Colchester, Cumberland and Victoria. July 12 - August 25, and April 14; also a specimen from Ragged Lake, near Halifax, dated February 8, 1918 (J. Redden). Food plants: *Ribes*, elm.

Nymphalis Kluk

295 *N. j-album* Bdv. & LeC. Compton Tortoise Shell.

Halifax, MacNab's Island, Fall River, Yarmouth, Digby, Annapolis, Truro, Stellarton. August 10 - October 5, and April 18. In September, 1944 a specimen was seen hovering about an alder thicket at Armdale; the following April I saw a number flying in the woods in the same vicinity, and on September 5 of the same year a fine specimen flew in an open window at the Nova Scotia Museum of Science and now rests in the collection there. I have not seen *j-album* in Nova Scotia since. Food plants: white birch, willow.

297 *N. milberti* Godt. Milbert's Tortoise Shell.

Armdale and Preston, Halifax County, Truro, Debert, Glenholme, Annapolis Royal, Stellarton, Sydney. August 16 - October 18, and April 19 - May 14. Generally rare, though when encountered, a number are usually found together. J. Redden collected five at Armdale between August 22 and 27, 1923, and I took a series of five at Annapolis on roadside flowers, September 11, 1946, after having found a single specimen there almost a month earlier on August 16. In 1952 it occurred in abundance at Debert and Glenholme, Colchester County. Larva on nettle and possibly elm.

298 *N. antiopa* L. Mourning Cloak.

Scarce as an adult, although I have found the larval colonies on willow at Smith's Cove, Annapolis, Lake LaRose, Annapolis County, and Oxford, Cumberland County. Adults from the vicinity of Halifax, Fall River, Digby, Annapolis, Grand Pré and Truro. July 31 October 10, and hibernated specimens April 11 - June 3.

Vanessa Fabr.

299 *V. atalanta* L. Red Admiral.

Halifax and vicinity, Digby, Annapolis, Truro, Parrsboro, Isle Haute, Southampton, Stellarton, Baddeck. May 15 - June 17, and July 18 - September 12. Scarcest of the three *Vanessas*. Larva on Urticaceae

300 *V. virginiensis* Dru. American Painted Lady.

Digby, White Point Beach, Stellarton, Halifax and vicinity. May 15, and July 27 - October 6. Common some seasons, though never in such abundance as *cardui.* Like the latter, this species is very fond of the blossoms of knapweed (*Centaurea*) and thistle. Bred from a larva on cudweed (*Gnaphalium*), although the preferred food is supposed to be pearl everlasting (*Anaphalis*).

301 *V. cardui* L. Painted Lady.

Present some seasons in enormous numbers everywhere, and in other years absent. Tends to be absent, or very nearly so, for two or three successive years before reappearing. Worn specimens apparently arrive as migrants in the spring, and in such seasons as these appear, a large summer brood follows. May 24 - July 12, and the summer generation from July 31 - September 10. Larvae commonly on thistle, burdock and hollyhock, and in 1952 I found larvae in great numbers feeding on beach wormwood (*Artemisia stelleriana*), near Tabusintac, N. B.

Limenitis Fabr.

321 L. *arthemis* Dru. Banded Purple, White Admiral.

Generally distributed, including Cape Breton. June 18 - August 11. Single brooded. Frequently taken, but never in the enormous numbers encountered in the White Mountains or the Adirondacks. Most commonly as single individuals resting on the road, through wooded areas. Bred at Halifax from larvae on *Amelanchier* and *Populus.* At Jefferson, N. H. the hibernacula may be found quite commonly late in the fall on yellow birch, usually on branches overhanging streams.

325 *L. archippus* Cram. Viceroy.

Locally common in old fields, meadows and open, scrubby woods throughout, including Cape Breton Island. Two broods, June 24-July 27, and August 12 - September 5. At Three Brooks, Pictou County, larvae were common on willow, scarcer on aspen.

LYCAENIDAE

Strymon Hbn.

373 *S. melinus* Hbn. Gray Hairstreak.

Digby, June 20, 1907; South Milford, Annapolis County, June 27, 1951; Coldbrook, Kings County, May 24, 1952; Armdale, July 23, 1923 (J. Redden); bred from a larva feeding on *Comptonia* at Petite Riviere, Lunenburg County in August, 1948. Both the South Milford and Coldbrook specimens were taken hovering over, or alighting upon, sweet fern. Rare. Larval food plants farther south include *Malva, Humulus, Polygonum, Cynoglossum, Crataegus, Hypericum* and garden beans. The name *humuli* Harris may be used in a racial sense for northeastern specimens.

381 *S. acadica* Edw. Acadian Hairstreak.

Taken not uncommonly in and near a wet, shrubby meadow at Three Brooks, Pictou County. July 12 - August 22, 1942 - 47. Most were taken resting on the coarse marsh grasses or the low willows, although a few were found some distance from this spot, about shrubbery in old fields. Once seen feeding on thistles. Two more taken in a similar meadow near Southampton, Cumberland County, August 1, 1952. The larval food is willow.

387 *S. falacer* Godt. Banded Hairstreak.

South Milford, Annapolis County, July 10, 1938, a small female (McDunnough). The food plant in this region would probably be oak.

389a *S. liparops strigosa* Harr. Striped Hairstreak.

Four specimens only. Armdale, July, 1941 (on a bean plant in the garden); Yankeetown Road, Halifax County, July 24, 1952; Petite Riviere, August 13, 1936 (McDunnough); Three Brooks, Pictou County, July 27, 1943 (resting on willow). Recorded food plants include oak, willow, blueberry, *Amelanchier*, *Prunus* and *Rubus*.

Incisalia Scud.

403 *I. augustinus* Westwood. Brown Elfin.

Locally common on bogs and heathy barrens throughout southern Nova Scotia north to Pictou County and a bog near Baddeck. Scarcity of more northern records doubtless due only to lack of early spring collecting in those areas. May 7 - June 14. The larvae will eat the flowers and fruit of leatherleaf (*Chamaedaphne*), and are reported on *Vaccinium* and *Kalmia angustifolia*. *Augustinus* is the commonest *Incisalia* in Nova Scotia.

407 *I. henrici* G. & R. Plate II, Figures 1 and 2.

Fall River, Halifax County, June 4, 1919; Digby, May 24, 1905, May 26, 1908; Armdale, May 24, 1943, June 6, 1943; Halifax watershed area, June 1, 1951 (McDunnough). Rare. Found in a habitat similar to *augustinus* and *polios*. Food plants: *Prunus*, *Vaccinium*.

409 *I. polios* Cook and Watson. Hoary Elfin.

Halifax and vicinity, Mount Uniacke, Aldershot, Lake Kejimukujik, Caledonia, Bangs' Falls, Queens County, Digby. May 2 - June 1. Like *augustinus*, *polios* tends to frequent small, sunny, sheltered bogs, or the sheltered margins of larger bogs where there is a thick growth of *Chamaedaphne*, the flowers of which attract the butterflies. *Polios* is not always confined to such locations, often turning up in dry, sandy areas about patches of *Vaccinium* and *Kalmia*, sometimes in company with *niphon*, as well as *augustinus*.

413a *I. niphon clarkii* Frmn. Banded Elfin.

Armdale, Waverley and Sackville, Halifax County, Aldershot and Coldbrook, Kings County, Lake Kejimukujik, Annapolis, Stellarton. May 9 - June 14. Uncommon, but tends to be less local than the other species. Larva on pine, probably including *Pinus strobus*, that being the only pine growing in some of the localities where it occurs.

Erora Scud.

418 *E. laeta* Edw. Early Hairstreak. Plate II, Figures 3 and 4.

This species, one of the rarest of North American butterflies, is known from two localities in Nova Scotia. Mr. John Russell informs me that in the early days of his collecting around Digby, he actually took *laeta* in some numbers at blackberry blossoms in sunny clearings on the beech covered slopes of Mount Beaman, near Digby. Available data: June 2, 1908, June 7, 1906, June 19, 1905, June 16, 1931. One of these is in the collection of the Nova Scotia Museum of Science, and I saw another in the collection of the late Mr. H. G. Payne. During the past decade I have twice tried to relocate *laeta* on Mount Beaman, accompanied once by Mr. Russell, but both attempts failed. The old clearings near the top where the blackberry vines grew have been engulfed by the surrounding forest, and no longer offer good collecting.

The second locality is at Armdale where, on May 14, 1944., I took a fresh female at rest on a clump of *Corema* (Broom crowberry) on the barren summit of a hill, actually a granite outcrop, lying between Ashburn golf course and the Chain Lakes. This seemed an unusual habitat but since it was a windy day, the butterfly could readily have blown up from the surrounding forest of birch, maple, beech and aspen. Larvae have been reared on beaked hazelnut (*Corylus*).

Feniseca Grt.

419a *F. tarquinius nova-scotiae* McD. The Harvester. Plate II, Figure 7.

McDunnough, Can. Ent., Vol. 67, pp. 211-212, 1935.
Type locality: South Milford, Annapolis County.

In this race the marginal row of dark spots on the secondaries has a tendency to become obsolete, or wholly wanting. All the Nova Scotian specimens taken as adults that I have seen lack the marginal spots entirely, yet of well over one hundred specimens reared, about fifty percent possessed them, though in most cases more reduced than in normal *tarquinius*. Armdale, Spryfield, Oldham, French Village, Fall River, Petite Riviere, South Milford, Digby, Truro, Stellarton, Three Brooks. June 22 - September 7, mostly in July. Bred from larvae found in colonies of woolly alder aphids at Armdale, Waverley, Fall River, Auburn and Annapolis.

Lycaena Fabr.

434a *L. epixanthe phaedra Hall.* Bog Copper. Plate II, Figures 5 & 6

Common in cranberry bogs throughout the province. The most southerly records are from White Point Beach, and from Karsdale (near Granville Ferry); the most northerly ones from Pleasant Bay and Terre Noire, Inverness County. One brood, June 14 - August 1. The larvae feed on cranberry (Cook and Watson, Can. Ent., Vol. 40, pp. 85-88).

I follow Klots's usage of the name *phaedra* Hall, rather than Benjamin's resurrection of *amicetus*, a Boisduval manuscript name never published, but listed as a synonym by Scudder. The latter name, whether attributed to Boisduval or Scudder, may be regarded as a *nomen nudum.*

435 *L. phlaeas americana* Harris. American Copper.

Common in fields and pastures wherever the larval food, sheep sorrel (*Rumex acetosella*) grows. Records from many localities from White Point Beach to Ingonish. It is one of the few butterflies that can still be found in large numbers within the city limits of Halifax. Two broods, June 4 - July 7, and August 1 - September 29.

Lycaeides Scud.

449d *L. argyrognomon empetri* Freeman. Plate II, Figures 8 and 9.

Freeman, Can. Ent., Vol. 70, p. 62, 1938.
Type locality: Baddeck, Cape Breton Island.

Present on many acid bogs, coastal barrens and headlands south to Halifax County. It is abundant about *Empetrum* on the coastal cliffs at Grand Etang and Cap Rouge and on the mountains above Cheticamp and Pleasant Bay. Farther south it occurs in great numbers on the barren areas of eastern Guysborough County near Cape Canso, and in Halifax County is common at times on several bogs not far from the city, and about patches of *Empetrum* on the coast at Herring Cove and near Ketch Harbour. *Empetri* also occurs plentifully on the two bogs near Mount Uniacke, one of which lies five miles within Hants County. June 30 - August 9, but at its best in early July. It is doubtful if *empetri* occurs much farther south, but should be sought in suitable locations along the south coast, and on the cliffs bordering the Bay of Fundy. Observed ovipositing on *Kalmia*, *Empetrum* and *Ledum* (Freeman), though its invariable association with *Empetrum*, even when the others are absent, constitutes strong evidence that this is the true host plant.

Material from the eastern end of Prince Edward Island (Canadian National Collection) matches *empetri*, but specimens taken along the south shore of the Bay of Chaleur and near Pokemouche, N. B. have smaller spots, and resemble *aster* Edw.

Plebeius Kluk

453 *P. saepiolus amica* Edw. Greenish Blue.

The Payne collection contained a single female from Digby, June 2, 1908, presumably taken by Russell. It is abundant in New Brunswick from the Miramichi River northward in early July, though perhaps somewhat past its best at that time, and occurs also in northern Maine. Food plant: clover. Two larvae on sweet clover (*Melilotus alba*), Bartibog, New Brunswick, 1952 are probably this species. They are hibernating as pupae.

Glaucopsyche Scud.

473a *G. lygdamus couperi* Grt. Silvery Blue.

A series of specimens taken about beach pea in Point Pleasant Park, Halifax, June 13 - 15, 1950, June 21, 1951 and June 9, 1953 appear closer to this race than to *mildredae* Cherm. On the Tantramar Marshes just over the boundary near Sackville, New Brunswick, I found *couperi* common around patches of wild vetch (*Vicia*), on July 8, 1950 and June 25, 1952. It seems likely that further collecting in that vicinity will reveal its presence also on the Nova Scotian side of the marshes.

473g *G. lygdamus mildredae* Cherm. Plate II, Figures 10 and 11.

F. H. Chermock, Can. Ent., Vol. 76, p. 216, 1945.
Type locality: Baddeck, Cape Breton Island.

Described from Kidston Island, opposite Baddeck. Common everywhere along the shore of Baddeck Bay where beach pea (*Lathyrus japonicus*) grows. Also taken on a sand bar at Eel Cove, St. Ann Bay, and in back of a beach near Cap Rouge. June 17 - July 20. Many reared from larvae on beach pea at Baddeck and Eel Cove. Hibernates as a pupa.

Lycaenopsis F. and F.

475a *L. argiolus lucia* Kby. Spring Azure, Jenny Lind.

Including a high proportion of form *marginata* Edw., (almost fifty per cent), and a few of form *violacea*, emerging late, usually about the end of June or the beginning of July. *Lucia* and form *marginata* abundant throughout, characteristic of open woods and bog margins before the leaves are out in the spring. Form *violacea* seems localized, occurring in certain areas only. Probably all one extended brood, from April 22 to July 19, except for a few rare instances of second generation individuals. One of these on MacNab's Island, October 4, 1917, and another near Annapolis, August 9, 1946, both of the *violacea* type. Larvae frequently in flower heads of *Aralia hispida* and *Viburnum cassinoides*, though reported on many other plants elsewhere.

Superfamily HESPERIOIDEA

HESPERIIDAE

Not a great deal is known about the early stages of our Skippers, yet it seems likely that all of them, except *Erynnis* and *Thorybes*, feed upon grasses. I have found the larvae of *E. icelus* repeatedly on aspen and willow, and *E. juvenalis* on oak. Judging from the vegetation in areas where it occurs, I should guess that the latter feeds on beech also. They go into hibernation as partly grown larvae. *T. pylades* is reported on clover and other Fabaceae.

Thorybes Scud.

505 *T. pylades* Scud. Northern Dusky Wing.

Three Brooks, Pictou County, July 2, 1944 (2), July 12, 1942; Great Village, Colchester County, no date (Hall).

Erynnis Schrank

541 *E. icelus* Scud. and Burg. Dreamy Dusky Wing.

Generally distributed in or near woodland in Digby, Annapolis, Queens, Kings, Halifax, Cumberland, and Pictou counties. May 16 - July 16. Presumably present everywhere, though overlooked through insufficient spring collecting.

551 *E. juvenalis* Fabr. Juvenal's Dusky Wing.

Halifax, Armdale, Coldbrook, Lake Kejimukujik, and along the Liverpool Road between Lequille and Greywood, Annapolis County. May 24 - July 15. At Lake Kejimukujik *juvenalis* occurred quite commonly in beech woods, May 30 - 31, 1950. There was no oak in the vicinity.

Carterocephalus Led.

563a *C. palaemon mesapano* Scud. Arctic Skipper.

Various localities in Halifax County, and at South Milford, Point Prim (near Digby), Stellarton, Three Brooks, Pictou County and Baddeck. June 12 - July 25. Very local; in marshy places where it frequents the coarse grasses.

Ancyloxypha Feld.

567 *A. numitor* Fabr. Least Skipper.

The first record was netted by Dr. McDunnough in a grassy roadside bog near South Milford, July 5, 1946. Careful search of that vicinity by Dr. McDunnough and the author failed to produce any others. Since then I have seen one female taken by an Agricultural College student at Canard, Kings County, July, 1950, and I took another male in a grassy marsh near Aylesford, July 1, 1951. Seen at Green Bay, Lunenburg County, July 17, 1953.

Hesperia Fabr.

——— *H. laurentina* Lyman. Laurentian Skipper. Plate II Figures 12 and 13.

Records from only four counties. Parrsboro and vicinity, August 8-17, 1944; Blue Mountain, Pictou County, August 13, 1933 (Perrin); Three Brooks, Pictou County, August 1 - 22, 1942 - 47, and seen once in early September; James River, Antigonish County, August 4, 1948; Sackville, Halifax County, August 24, 1950. Frequents dry, open fields and grassy hillsides. The butterfly would seem to be invading the province from the west.

591 *H. leonardus* Harr. Leonard's Skipper.

One old specimen from Digby in the Canadian National Collection. Like the preceding, *leonardus* flies in late summer.

Polites Scud.

611 *P. themistocles* Latr. Tawny-edged Skipper.

Occurs nearly everywhere from Digby to Cape Canso, and at Baddeck in Cape Breton. June 17 - July 27. Common in grassy situations such as poor hay fields.

614 *P. peckius* Kby. Peck's Skipper.

A little commoner than *themistocles* and in similar locations, Digby to Baddeck. Undoubtedly general. June 23 - July 31. Second brood specimens rare; one taken at Coldbrook, August 28, 1952.

618 *P. mystic* Scud. The Long Dash.

Numerous localities from the southern counties north to Cumberland and Pictou, and eastward to Cape Canso and Baddeck. June 23 - July 31. Also occurring in open, grassy places.

Poanes Scud.

624 *P. hobomok* Harr. Hobomok Skipper.

Digby and Annapolis to Pictou, and north-eastward to Ingonish, June 2 - August 1. An early species and one of the commonest skippers. *hobomok* prefers sunny, sheltered places in or bordering the woods. Dimorphic female *pocahontas* Scud. does not occur.

Atrytone Scud.

642a *A. ruricola metacomet* Harris. Dun Skipper.

Three Brooks, Blue Mountain and Groveland, Pictou County, Londonderry, Colchester County, Loch Lomond, Richmond County, Baddeck, Mount Uniacke, Armdale, Centreville. July 1 - August 13. Usually occurring together with the species of *Polites* but less commonly, tending to show a distribution pattern similar to *Hesperia laurentina*.

Amblyscirtes Scud.

660 *A. vialis* Edw. Roadside Skipper.

Fall River, Halifax County, June 2, 1921, June 12, 1906, 6 specimens (Perrin). White Point Beach, June 23 - 26, 1953, 7 specimens (Mc.D.).

661 *A. hegon* Scud. Pepper and Salt Skipper. Plate II, Figures 14 and 15.

Armdale, Waverley and Fall River, Halifax County, Three Brooks, Pictou County, Annapolis. May 31 - July 2. About twenty specimens examined. Scarce and very local; in moist, grassy spots in the woods and along roadside ditches.

Superfamily SPHINGOIDEA

SPHINGIDAE

Sphinginae

Herse Oken

693 *H. cingulata* Fabr.

Five specimens taken. Crawfalls, near Musquodoboit, Halifax County, July, 1908 (A. P. Silver); Canning, Kings County, August 10, 1924 (H. G. Payne); Halifax, October, 1944, (at rest on the side of a building); Halifax, October 8, 1952, a very battered specimen; Cow Bay, Halifax County, October, 1952, a rather fresh specimen. Three of these are in the collection of the Nova Scotia Museum of Science. Larvae on Convolvulaceae in the southern United States.

Phlegethontius Hbn.

697 *P. quinquemaculata* Haw.

South Gut, Cape Breton, September 6, 1935, Rod McLeod (H. G. Payne collection); Halifax, August 9, 1949. The larva is the well known tomato worm of the eastern United States, but there is no evidence that it breeds here.

Ceratomia Harr.

706 *C. amyntor* Hbn

Annapolis Royal, Bridgetown, Lawrencetown, Kentville, Truro, Wilmot, Chignecto Mines, Baddeck. June 16 - July 23. Not nearly as common as the following species. Larvae on elm in the Annapolis Valley.

707 *C. undulosa* Wlk.

Various localities in Annapolis, Digby, Queens, Halifax and Pictou counties. In the vicinity of Annapolis this is about the commonest Sphingid. June 9 - July 28; once on September 4. Have found larvae on ash.

Sphinx L.

719 *S. chersis* Hbn.

Digby, Annapolis, Granville Ferry, Bridgetown, Lawrencetown, Berwick, Bedford, Truro, Stellarton, and "Cumberland County". June 16 - August 1, with the peak of emergence about mid-July. I found it common only in Annapolis County, where the moths came to light, and to blossoms of dogbane and evening primrose. A larva on ash at Waverley.

727 *S. kalmiae* A. & S.

Frequent records from Barton, Digby County and White Point Beach north to Pictou County and Baddeck. June 16-August 5. One of the few Sphingids that comes to bait. The food plants commonly given for *kalmiae* are ash, lilac and privet, but its general occurrence here suggests an association with some commoner indigenous plant. The presence of white and black ash, native though scattered and local, hardly explains the frequent occurrence of the moth everywhere.

728 *S. gordius* Cram.

The most abundant of our Sphingidae. Taken in numerous localities from Barrington Passage, near Cape Sable, to Baddeck. Single brooded; May 24 - July 29. Up to two dozen examples at light in one evening, and I have seen it hovering at dusk in countless numbers over dogbane blossoms near Digby. *Gordius* is also very fond of the flowers of evening primrose, lilac, honeysuckle, sweet-scented summer phlox (rocket) and other garden plants. Evidently breeds abundantly on bogs, blueberry barrens and coastal barrens, and is one of the commonest moths at light in such locations. Larvae reared on blueberry, *Comptonia* and *Myrica gale*. Only one of the striking, wine-colored larvae seen—on *Myrica*. Other writers report larvae on apple, ash and other plants.

729 *S. luscitiosa* Clem. Plate II, Figure 16.

Dartmouth, June 12, 1910 (Perrin); Armdale, July 19, 1945, a female at light; Digby and vicinity, June 17, 1907 and others without date. Decidedly rare. Mr. John Russell informs me that he bred it *ex ovo* and from larvae on a shiny-leaved species of willow at Digby.

730 *S. drupiferarum* A. & S.

Amherst, Cumberland County, June 20, 1941 (H. G. Payne). Glenholme, Colchester Co., June 26, 1952 (W. Harrington). Food plants: apple, plum, cherry, lilac.

Lapara Wlk.

736 *L. bombycoides* Wlk.

Widely distributed from Digby and Queens counties to Baddeck, but never common. Probably present wherever pine grows. June 8 - July 30. Larva without a caudal horn, green, striped with white, yellow and violet, twice on *Pinus strobus* near Mount Uniacke.

Smerinthinae

Smerinthus Latr.

739 *S. jamaicensis* form norm. *geminatus* Say

Digby and White Point Beach to Northumberland Strait, and in Cape Breton at Baddeck. Common throughout. May 22 - August 16, one brood. The name *jamaicensis* is supposed to have been based on the rare form with one blue spot, undivided by a black bar. This form turned up once at Annapolis, July 29, 1946. Food plants: birch, poplar, willow, wild cherry.

740 *S. cerisyi* Kby.

Acaciaville, Digby north to Glenville, Cumberland County (common), Great Village, Stellarton, Baddeck. Widely distributed, though not usually as plentiful as *geminatus*. May 29 - July 29, mostly in June. Larvae not uncommon on willow.

Paonias Hbn.

741 *P. excaecata* A. & S.

Queens and Digby counties to Baddeck. Another of the commoner Sphingids. June 15 - August 11. Bred from larvae on birch at Parrsboro (McDunnough). Probably a rather general feeder on deciduous trees.

742 *P. myops* A. & S.

Scarcer than *excaecata* and more local. Truro, Glenholme, Great Village, Chignecto Mines, Stellarton, Baddeck, Bedford, Armdale, Lawrencetown, Annapolis County, Annapolis Royal. June 13 - July 28, at light. Females rarely taken. The probable food plants here are *Prunus virginiana* and *P. serotina*, and the distribution of *myops* seems to coincide well with areas where these grow commonly.

Cressonia G. & R.

744 *C. juglandis* A. & S.

Fenwick, Cumberland County, 1938 (A. D. Hall); Stellarton, Pictou County, no date; Lequille, Annapolis County, June 22, 1946, June 13, 14, 1949; Acaciaville, Digby County, June 15, 1949 (2). Seemingly rare, except possibly in the beech and oak woods of Annapolis and Digby counties. A larva on introduced copper beech at Armdale was probably *juglandis*, but failed to yield an adult.

Pachysphinx R. & J.

745 *P. modesta* Harr.

Numerous recent records from most counties north to Baddeck, Victoria County. June 13 - July 28, at light. Like most of the larger Sphingidae, it may be found in greatest numbers about street lamps in small town and villages. A number of larvae found together on aspen, Waverley Game Sanctuary.

There is evidence that *modesta* reached its present abundance in relatively recent years. Up to the time of their catalogue of 1909, and the additions of 1915), neither Perrin nor Russell appeared to have taken the species, although they reported earlier records from Halifax (Andrew Downs) and Truro, (June, 1901, Lucy Eaton).

Macroglossinae

Aellopos Hbn.

964-5 *Aellopos* sp.

A representative of this genus was supposed to have been taken at Sydney in the late eighteen-nineties by Miss Margaret Brown, one of Nova Scotia's best known amateur botanists. Miss Brown informs me that she sent the specimen to James Fletcher, then Dominion Entomologist, and it was determined by him as *A. tantalus* L. The specimen was retained for the National Collection, although there is no specimen of *Aellopos* bearing a Nova Scotia label there now.

Hemaris Dalm.

767 *H. thysbe* form *cimbiciformis* Steph.

All specimens seen from the Maritimes have been of this form. Generally distributed. Taken from Barrington Passage to Baddeck and Cape Smoky, Victoria County. One brood, June 12 - August 11. Bred from Larvae on *Viburnum cassinoides* at Halifax, Petite Riviere and White Point Beach.

768 *H. gracilis* G. & R. Plate III, Figure 5.

South Milford, Annapolis County, June 28, 1951; South Eastern Passage, Halifax County, June 9, 1921 (Perrin); Southampton, Cumberland County, August 5, 1949, two seen and one taken; Fenwick, Cumberland County, 1938 (A. D. Hall); and another specimen without data but undoubtedly Nova Scotian. Rare. The dates suggest two broods, especially so since the August specimens appeared fresh. The Southampton specimens were visiting Joe Pye Weed. Larval food plant unknown.

770a *H. diffinis aethra* Stkr.

Very common locally, but not so inclined to occur everywhere, like *thysbe*. Lequille, South Milford and Lake Kejimukujik north to Truro, and at Stellarton and Three Brooks, Pictou County. May 9 - August 1, probably all one brood. Very common at lilac blossoms at Lequille, Annapolis County in early June, and visiting flowers of blueberry and wild bush honeysuckle in similar numbers along a railway embankment near Halifax. Ova and larvae on *Diervilla lonicera* at Armdale.

Philampelinae

Pholus Hbn.

772a *P. satellitia pandorus* Hbn.

Armdale; bred a fine, large specimen July 20, 1952 from a pupa found on the ground under an *Ampelopsis* vine in the garden. There are no other records.

776 *P. fasciatus Sulz.* Plate III, Figure 1.

Crawfalls, near Musquodoboit, July 1902, one female (A. P. Silver); MacNab's Island, August 29, 1907, one male (Perrin); Granville Ferry, Annapolis County, August 19, 1910 (H. G. Payne). It is a curious thing that most specimens of *Pholus* taken here should have been of this subtropical species, rather than the more northern *achemon* or *pandorus*, but the records are authentic. Two of the *fasciatus* are in the Nova Scotia Museum of Science collection, and the one from MacNab's Island is in remarkably fresh condition. Dr. Forbes gives *Jussieua* as the larval food.

Darapsa Wlk.

780 *D. pholus* Cram.

Acaciaville and White Point Beach to Baddeck. Apparently general. June 13 - August 6. At times abundant, coming more commonly to baited trees than any other Sphingid. Bred from larvae on *Viburnum cassinoides*.

Amphion Hbn.

785 *A. nessus* Cram.

Chignecto, 1939 (A. D. Hall); Lequille, Annapolis County, June 12, 1946 (in the Canadian National Collection). At the latter locality a specimen was taken at lilac blooms in the bright sunshine of midmorning. On the same day a second was seen visiting the same bush just before sunset, but was not captured. Another specimen seen from Windsor, without date. Larva probably on *Ampelopsis*.

Proserpinus Hbn.

790 *P. flavofasciata* Wlk.

Digby, May 24, 1906 (J. Russell). Mr. Russell tells me that the moth was hovering over dandelion flowers when taken. The specimen is apparently lost. The western race, *ulalume*, feeds on *Epilobium*.

Choerocampinae

Celerio Oken.

798a *C. gallii intermedia* Kby.

MacNab's Island, Digby, Round Hill, Truro, Great Village, Stellarton, Three Brooks, Springhill, Baddeck and Sydney. June 21-July 10. Generally scarce. In Pictou County I once saw the moths coming in numbers to lilac at dusk and in early morning. Larvae found on *Oenothera* at Great Village were probably this. *Epilobium* is another food plant.

799 *C. lineata* Fabr.

Although this is at times the commonest of North American Sphingidae, records for Nova Scotia are rare. In the Nova Scotia Museum of Science collection, there is one specimen taken on MacNab's Island in 1900 (Perrin). I have seen a number of specimens from the vicinity of Digby, mostly taken by Russell, indicating that *lineata* may, some seasons, invade that corner of the province as a migrant. Larval food plants most commonly given are purslane and evening primrose.

Superfamily SATURNIOIDEA

SATURNIIDAE

Platysamia Grt.

(*Hyalophora* Duncan)

804 *P. cecropia* L.

Armdale, MacNab's Island, Lower Sackville, Halifax County, Mount Uniacke, Stellarton, Annapolis and Digby. June 4 - July 11. Not as common near Halifax as it used to be, though plentiful in recent years in Digby and Annapolis counties. Cocoons on choke cherry, pin cherry, *Amelanchier*, hawthorn, *Spiraea*, *Viburnum*, birch, alder, poplar and red maple.

806 *P. columbia* Sm.

Bridgetown, Annapolis County, June 16, 1914 (G. E. Sanders). One male, rather worn. On June 25, 1952 I took a fresh female at light in boggy, black spruce - jack pine forest at Dorchester, N. B., not far from the Nova Scotia boundary, and it should be looked for in similar locations in this province. Larvae, from eggs laid by this female, were reared on larch, the usual food plant of *columbia*. As with *cecropia*, the cocoons remain on the trees all winter, but are smaller and often compressed against the rough and gnarled branches of the tamaracks.

There has since been taken an additional record at White Point Beach, July 4, 1953, one male at light (McDunnough).

Actias Leach

811 *A. luna* L.

Halifax and vicinity, St. Margaret's Bay, Bridgewater, Annapolis Royal, Digby, Acaciaville. May 31 - July 24. The data suggests that *luna* is commonest in the southern part of Nova Scotia. Where found, it is not especially rare, and at Annapolis came to light in about the same numbers as *polyphemus*. The chief food in this area possibly birch. Young larvae, newly hatched, refused oak.

Telea Hbn.

812 *T. polyphemus* Cram.

Halifax and vicinity, Digby, Annapolis, Truro, Stellarton, Baddeck, June 7 - Aug. 4. Very common. Bred a number of times from larvae on birch and willow.

CITHERONIIDAE

Anisota Hbn.

846 *A. virginiensis* Dru.

Armdale, Halifax, Dartmouth, Mason's Point, Halifax County, Stellarton, Lawrencetown, Annapolis County. June 10 - July 15. Females moderately frequent at light in the vicinity of Halifax; very rare elsewhere. Some seasons not seen at all. Have never taken a male, although the Perrin collection contained two. Reared from eggs and larvae on red oak at Armdale.

848 *A. rubicunda* Fabr.

Many localities from Digby and White Point Beach to Springhill, and in Cape Breton at Whycocomagh and Baddeck. Seems to be generally distributed and common. May 28 - August 16, probably all one brood. In contrast to *virginiensis*, it is the males of *rubicunda* that commonly come to light. Reared from eggs and larvae on *Acer rubrum.*

Superfamily **NOCTUOIDEA**

EUCHROMIIDAE

Cisseps Franclemont

871 *C. fulvicollis* Hbn.

Numerous specimens taken through the Annapolis Valley from Annapolis Royal to Grand Pré, and at Great Village, Colchester County mostly at light. Scarcer elsewhere; Bass River, Colchester County, Hubbards, Lunenburg County, and scattered individuals in Halifax County, at Armdale, MacNab's Island, Herring Cove and Port Wallis, usually flying about *Solidago* by day. Two broods, June 5-June 29, and August 9 - October 15. Larva not seen but probably on grasses and other low plants.

Lycomorpha Harr.

877 *L. pholus* Dru.

During the week of August 17 - 23, 1952, Mr. David Gray of Port Wallis, Halifax County, saw on four or five occasions, but did not capture, specimens that answer the description of this species perfectly. They were observed at several different places in that vicinity feeding by day at flowers of *Solidago.* I since captured two examples at Rocky Bay, Victoria County, July 31, 1953, flying about flowers of *Centaurea.*

Ctenucha Kby.

884 *C. virginica* Charp.

Petite Riviere and Digby to Pictou, and in Cape Breton at Baddeck. Generally distributed and abundant; at light and often by day, visiting flowers of *Solidago* and thistle. June 25 - August 1. Sometimes comes in enormous numbers to light, even on the Mount Uniacke bogs. The black, white and yellow tufted, hairy caterpillar common in spring on grasses.

NOLIDAE

Celama Wlk.

888 *C. cilicoides* Grt.

Debert, Colchester County, July 19, 1952 (W. Harrington). One specimen at light.

890 *C. triquetrana* Fitch. Plate III, Figure 2.

Lequille, Annapolis County, June 13 - 14, 1949; Acaciaville, Digby County, June 15, 1949; Lake Kejimukujik, May 29, 1950; Waverley, May 20, 1951. Scarce.

Sarbena Wlk.

897 *S. minuscula* Zell. Plate III, Figure 3.

Armdale, Waverley, Coldbrook, Auburn, Round Hill, Lequille, South Milford, Caledonia. June 1 - July 29, at light, and occasionally at rest on tree trunks. Much more frequently taken than *triquetrana.* Bred from a larva feeding on beech leaves at Lequille.

ARCTIIDAE

Lithosiinae

Lexis Wallgr.

905 *L. bicolor* Grt.

Great Village, August 7, 1947; Armdale, August 14, 1948. Only two specimens taken. Farther north, in Gloucester and Restigouche counties, New Brunswick, it was in certain localities one of the commonest moths at light in mid-July, 1950. The larvae of *bicolor*, as of all the Lithosiinae, are supposed to feed on lichens.

Crambidia Pack.

906 *C. pallida* Pack.

Acaciaville, Lequille, White Point Beach, Lake Rossignol, Centreville, Coldbrook, Mount Uniacke, Waverley, Sackville, Peggy's Cove, Armdale. July 22 - September 7, with the peak about mid-August. Sometimes abundant at light.

911 *C. casta* Pack.

Auburn, Kings County, August 27, 1952 (nine specimens); Aylesford, August 26, 1952, September 2, 1951. Apparently local.

Clemensia Pack.

952 *C. albata* Pack.

MacNab's Island, July 24, 1913; Bog, Prospect Road, August 11, 1951; Shad Bay, July 27, 1952; Digby, August 3, 1905, August 9, 1907 and 1908. Rare.

Hypoprepia Hbn.

958 *H. miniata* Kby.

Yarmouth (E. C. Allen), Acaciaville, Lequille, Round Hill, White Point Beach, Wolfville, Centreville, Mount Uniacke, Bedford, Fall River, Halifax County. July 19 - August 22. The specimens recorded by Perrin as *fucosa* belong here.

959 *H. fucosa* Hbn.

Annapolis Royal, Lequille, Round Hill, Mount Uniacke, Debert, Bass River, Prospect Road and Shad Bay, Halifax County. July 17 - August 18, at light. Neither species of *Hypoprepia* is common.

Arctiinae

Halisidota Hbn.

977 *H. caryae* Harr.

Digby, Annapolis, South Milford, and at Bedford, French Village and MacNab's Island in Halifax County. June 16 - July 11. Scarcest of the three *Halisidotas*. The black and white hairy larva on alder at Granville Ferry, on *Vaccinium* and oak at Bangs' Falls, Queens County.

980 *H. maculata* Harr.

Numerous localities from Digby and White Point Beach to Glenville, Cumberland County, Three Brooks, Pictou County and Baddeck. June 17 - August 1. The black and yellow hairy caterpillar is always common on alder and willow in the fall.

984 *H. tessellaris* A. & S.

Digby and Annapolis to Chignecto Mines, Great Village and Baddeck. June 10 - August 25. Commonest in Annapolis County and bred there from larvae on red oak. It seems likely that in localities where there is no oak, such as Baddeck, the larvae have an alternative food, perhaps beech.

Cycnia Hbn.

991a *C. tenera sciurus* Bdv.

Chignecto, 1940 (A. D. Hall); Lequille, Annapolis County, June 23, 29, 1946; Acaciaville, June 15, 1949. Larvae probably feeding on dogbane (*Apocynum*).

Euchaetias Lyman

1005 *E. oregonensis* Stretch

Much more frequent than the preceding but similarly local. Annapolis, Round Hill, Lawrencetown, Coldbrook. June 5 - July 13, at light. The host plant is dogbane.

Eubaphe Hbn.

Certain species of this genus have long been a source of difficulty for taxonomists. Not only is there considerable doubt about the application of some of the names, but the old question of which is a distinct species and which is not here remains paramount. Also, not only have one or two of the commonest species a tendency to break off into innumerable local strains throughout their range in North America, but the offspring from these reared under laboratory conditions are not always a good match for the parents.

Using the names as they are now most commonly applied, the most perplexing species or races in the east fall naturally into two fairly well defined groups, both represented here. They are what I shall call the *aurantiaca* group, and the *ferruginosa* group. Species of both groups may come with or without a dark border on the hind wing (both sexes) and whitish spots on the forewing (most often in females only). The differences are chiefly in size and shade or intensity of coloring, since there are no constant markings to rely upon. The genitalia show no visible differences, nor are there any food preferences to aid in separating species, since all *Eubaphes* will feed on almost any low, herbaceous plant. Excepting *lamae*, which is a bog dweller of diurnal habits, the *Eubaphes* show no definite environmental preferences that could serve as clues to their identity, and are just as likely to turn up in dense woods as on open blueberry barrens or old pastures.

In the first of the two groups there are *lamae* and *aurantiaca*. In a paper appearing shortly in the Canadian Entomologist, I have given a detailed characterization of *lamae*. But to summarize, it has very rich brown primaries, white spotted in many males as well as the females, it has pale orange or pinkish secondaries always heavily bordered with black—never immaculate, it is strictly a bog species and flies by day. *Lamae* appears to be about as good a species as might be expected in *Eubaphe*. What I am calling *aurantiaca* averages a little larger, is also richly colored (probably due to denser scaling and stronger pigmentation than in the *ferruginosa* complex), though has decidedly rosy or pale red secondaries (orange when faded), and usually a narrower marginal black band on the secondaries.

The *ferruginosa* group comprises a host of forms and minor geographical varieties, changing in appearance from north to south, or east to west throughout their range, but the population occupying Nova Scotia is quite constant, and would appear to be homogeneous. Our form is quite large (26 mm.), with deep pink primaries overlaid with brown scales, and paler pinkish-orange secondaries, usually immaculate, but sometimes marked with a weak blackish border or part of one. The same population continues into New Brunswick, but northward in that province it becomes a little larger, darker, and more often with blackish bordered secondaries.

1016a *E. laeta treatii* Grt.

Deerfield, Yarmouth County, Centreville, Mount Uniacke, Armdale, Oxford and Glenville, Cumberland County, Three Brooks, Pictou County, Baddeck. June 15 - July 28. Well distributed but occurs very sparingly. Two larvae under a log in May; these and others *ex ovo* reared on *Plantago.*

1019 *E. aurantiaca* Hbn.

In many localities from the vicinity of Digby, Lequille, South Milford northward to Glenville and eastward to Tory Creek, Guysborough County. Commonly at light, but often flushed from low shrubbery by day along railway embankments (Hubbards, Halifax County and on blueberry barrens (French Village, Halifax County). July 21 - August 27.

—— *E. lamae* Freeman. Plate III, Figure 4.

T. N. Freeman, Can. Ent., Vol. 73, p. 123, 1941.
Type locality: Baddeck, Vict. County.

Eastern Passage, Spryfield, Prospect Road, Hubbards, Peggy's Cove, Mount Uniacke, Aylesford, Lundy, Guysborough County, Baddeck. July 2-August 20. Always in bogs and flying by day. Rarely at light, and then probably only disturbed accidentally. The exact type locality is a bog to the right of highway Route 19, about a mile north west of Baddeck. Bred specimens, reared on *Plantago*, emerged in the fall.

1023 *E. ferruginosa* Wlk.

White Point Beach and Annapolis to Lakelands and Glenville, Cumberland County, and at Three Brooks and Stellarton, Pictou County. July 3 - September 4. Locally common, usually at light; occasionally flushed by day. Especially abundant at Great Village, Colchester

County. Most frequently in dry locations such as scrubby woods, cut or burned over areas, but a few present on bogs at Mount Uniacke and Aylesford.

Phragmatobia Steph.

1028a *P. fuliginosa rubricosa* Harr.

Armdale and vicinity, MacNab's Island, Great Village, Three Brooks, Baddeck, Wolfville, Auburn, Round Hill, Lequille, Acaciaville. June 6-August 15, at light. Locally common.

1029 *P. assimilans* Wlk. Plate III, Figure 8.

Granville Centre, Annapolis Royal, Round Hill, Mount Uniacke, Waverley, Armdale, Halifax watershed area, MacNab's Island, Stellarton. May 18 - June 23. Bred twice from larvae, one of which was crawling on the snow on a mild February day in the Waverley Game Sanctuary.

Apantesis Wlk.

1033 *A. virgo* L.

Yarmouth and White Point Beach to Port Howe, Cumberland County and Pictou. June 19 - August 28. Very abundant at light some seasons, especially in the Annapolis Valley and at Great Village. Reared from larvae under logs and flat stones at Armdale in May, always in fields and open, grassy places. A specimen of ab. "*simplex*" Stretch in the Canadian National Collection labelled "Nova Scotia, 1904".

1035 *A. parthenice* Kby.

Digby, Annapolis, Auburn, Kentville, White Point Beach, Miller's Lake, Halifax County, Truro, Great Village, Parrsboro, Stellarton. July 22 - September 4, mostly in mid-August. Scarce.

1037a *A. doris minea* Sloss. Plate III, Figure 6.

Lequille, Annapolis County, June 23, 1946; Greenwood, Kings County, June 12, 1945; near Peggy's Cove, Halifax County, June 8, 1953; Stellarton, no date. Decidedly rare.

1044 *A. virguncula* Kby.

Digby, Annapolis, Round Hill, Kentville, Mount Uniacke, Peggy's Cove, Halifax watershed area, Stellarton, French Mountain, Inverness County. June 12 - July 19, at light. Essentially a bog species in this region, occurring abundantly on the Mount Uniacke bogs, and on the boggy barrens at Peggy's Cove. Larvae reared *ex ovo* on *Plantago* and *Taraxacum*, but did not survive hibernation.

1051 *A. celia* Saund. Plate III, Figure 7.

A male of this species was bred May 18, 1951 from a larva collected April 29 in the sandy pine barrens at Aldershot, Kings County.

1059 *A. vittata* Fabr.

Great Village, no date (A. D. Hall); Granville Ferry (H. G. Payne); Centreville, Kings County, June 3 - 4, 1949 (seventeen males). All have yellow, not pink, hind wings.

Diacrisia Hbn.

1065. *D. virginica* Fabr.

Digby to Springhill, Pictou, French Mountain, Inverness County. Generally distributed and common. May 28 - August 8. The orange-brown, or pale yellow, hairy larva is one of the commonest "woolly bears", and may be found feeding on a variety of garden plants, including even *Ampelopsis.*

Isia Wlk.

1069 *I. isabella* A. & S.

Digby, Annapolis and St. Margaret's Bay to Stellarton and Baddeck. Frequent and presumably general. June 24 - July 30. The attractive caterpillar, brown in the middle and black at each end, is another very familiar "woolly bear".

Estigmene Hbn.

1070 *E. acrea* Dru. Plate IV, Figure 1, dark form.

White Point Beach and Digby to Springhill, Stellarton, Baddeck and Cheticamp. June 12-August 28. Common in most localities but strangely absent in others. Perhaps essentially a species of open agricultural areas or salt marshes, rather than heavily wooded country. Over fifty per cent are of a dark sooty form, approaching the western variety *dubia* Wlk. in appearance. The larva has both brown and blue-gray forms, and feeds freely on garden plants such as turnip and carrot, in addition to many kinds of weeds.

1072 *E. prima* Sloss. Plate IV, Figure 2.

Annapolis, Auburn, Greenwood, Aldershot, Mount Uniacke and various localities in Halifax County, Truro, Great Village, Baddeck. May 5 - July 19. Mostly on bogs and heathy barrens, though not wholly restricted to such locations. Larvae of this and *congrua* were reared together for comparison and were found to be quite differently marked, thus verifying that the two are correctly placed as separate species. Tha larvae were fed *Plantago.*

1073 *E. congrua* Wlk.

From approximately the same localities as *prima*, though not so inclined to occur on bogs and barrens. June 3 - July 5, often at light together with *Diacrisia virginica*. Locally common. Unrecorded prior to 1945; possibly confused with *virginica* by earlier collectors.

Hyphantria Harr.

1074 *H. textor* Harr.

Digby, Smith's Cove, White Point Beach to Baddeck. General. June 8 - August 26. Some specimens have black-spotted primaries, but I think that these are merely forms of *textor*, not *cunea* Dru.

Parasemia Hbn.

1092 *P. parthenos* Harr.

Records for many localities from White Point Beach and Annapolis to Glenville, Cumberland County and Stellarton. No Cape Breton specimens seen, but it is certainly to be expected there. June 25 - July 30. Rare or absent some seasons and at other times abundant. In 1952 I took almost one hundred specimens at light in Halifax County. all but one being males. It does not seem limited to any special habitat but when common occurs everywhere. The larva has been described, and is typically Arctian in its omnivorous feeding habits.

Arctia Schrank

1098d *A. caja americana* L.

Annapolis Royal, Round Hill, Granville Ferry, Truro, Debert, Chignecto, Stellarton, Mulgrave. July 7 - August 17, about twelve specimens, mostly taken between 1908 and 1940. Most recently at Debert, 1952. Scarce.

Utetheisa Hbn.

1099 *U. bella* L.

MacNab's Island, August 22, 1909, August 23, 1908, September 19, 1906; Halifax, September 8, 1941; Mount Uniacke, August 7, 1949. Last two specimens rather worn, and flying about *Solidago* by day.

Haploa Hbn.

1103 *H. lecontei* Guer.

Including form *militaris* Harr. Kentville, Armdale (once only), Glenholme, Great Village, Bass River, Stellarton and Three Brooks, Pictou County, Baddeck. June 20 - July 31. At light and flushed from vegetation by day, usually in low, damp woods or wooded margins of meadows, perhaps breeding commonly in the sedimentary rock areas only. Food plants might include certain Boraginaceae (such as *Cynoglossum*, *Lappula*, *Symphytum*), and horse gentian (Saunders, Can. Ent., Vol. 1, page 20). I once tried rearing larvae *ex ovo* on willow, but all died when about one third grown.

AGARISTIDAE

Alypia Hbn.

1116 *A. langtoni* Couper

Digby, Hubbards, Todd's Island (St. Margaret's Bay), MacNab's Island, Fall River, Three Brooks, Pictou County, Baddeck. June 28 - July 25. Always scarce. Larvae probably on *Epilobium*.

PHALAENIDAE

Pantheinae

Colocasia Ochs.

1122 *C. flavicornis* Sm. Plate IV, Figure 3.

A pale race with much of the grayish scaling of normal *flavicornis* replaced by pure white. From Annapolis, Digby and Queens Counties only. Acacia Valley, June 15, 1949; Granville Ferry, July 1, 1908, five specimens (H.G. Payne); Lequille, June 11, 1949; Lake Kejimukujik, May 29, 30, 1950, at light. In the last locality the moth seemed commonest in pure stands of beech and elsewhere it occurred where there was beech and also oak, so it may well be that the larvae feed on Fagaceae.

1123 *C. propinquilinea* Grt.

Annapolis Royal, Armdale, MacNab's Island, Stellarton, Baddeck. June 13 - July 27. More widely dispersed than *flavicornis*, and never as plentiful in any one locality. Birch, walnut, maple, oak, beech (Smith and Dyar).

Panthea Hbn.

1125a *P. acronyctoides albosuffusa* McD.

McDunnough, Can. Ent., Vol. 69, p. 153, 1937.
Type locality; White Point Beach, Queens County, N. S.

Well distributed but uncommon. Annapolis County and White Point Beach north to Three Brooks, Pictou County, and in Cape Breton Island to Baddeck and the Valley of the Cheticamp River. June 11 - August 22. Larva on spruce, and probably fir and hemlock.

1130,1 *P. pallescens* McD. Plate IV, Figure 4.

McDunnough, Can. Ent., Vol. 69, p. 153, 1937 and Vol. 74, p. 94.
Type locality: White Point Beach, Queens County.

White Point Beach, Lake Rossignol and Annapolis to Stellarton and Baddeck. June 10 - August 24, at light. An unusually early record at Cole Harbour, May 22, 1951 (W. Harrington). Commoner than *albosuffusa*. Long series taken at Armdale and Lequille. Larvae beaten from White Pine.

Charadra Wlk.

1135 *C. deridens* Gn.

Well distributed from Digby to Baddeck and the Valley of the Cheticamp River. Quite frequent at light, June 1 - July 26, with a straggler, possibly a second brood emergence, on September 16. Bred from larvae on beech at Smith's Cove and Annapolis, in shelters formed by tying two leaves together. Also supposed to feed on oak, birch and elm.

Raphia Hbn.

1141 *R. frater* Grt.

Records from Digby County to Glenville, Pictou and Baddeck. Presumably occurs wherever the food plant, aspen, grows. June 3 - August 2.

Acronictinae

Acronicta Ochs.

1148 *A. americana* Harr.

Occurs with moderate frequency over the whole area north at least to Baddeck. June 19 - September 5, at light and bait. The large yellow, hairy caterpillar with black hair pencils commonly found on maple.

1151 *A. dactylina* Grt.

From White Point Beach and Digby to Northumberland Strait, and in Cape Breton to Baddeck and Cheticamp. Usually commoner than the preceding. June 16 - August 25. The hairy, chocolate-colored caterpillar on alder and willow, but nearly always parasitized.

1153 *A. lepusculina* Gn.

Annapolis, Greenwood, Mason's Point, Halifax County, Armdale, Stellarton, Baddeck. Scarce. More from Baddeck than elsewhere. June 21 - July 21. On willow on Nantucket (Thaxter); Populus (Hy. Edw.).

1154a *A. leporina vulpina* Grt.

Digby, Annapolis, Halifax, Armdale, MacNab's Island. June 24 - August 9, at light. Infrequent. On poplar and willow. Thaxter mentions also birch as a food plant.

1155 *A. innotata* Gn.

White Point Beach and Digby to Baddeck and Cheticamp. Often common at both light and bait. June 10 - August 4. On poplar.

1157 *A. radcliffei* Harv.

Digby, Lequille, South Milford, White Point Beach, Armdale. June 20-August 10, mostly at bait. Not common. Bred on Martha's Vineyard from a striped larva feeding on *Amelanchier* (Dr. Frank Morton Jones). Both Dyar and Thaxter bred it on *Prunus serotina*, and Thaxter also mentions apple as a food plant.

1159 *A. tritona* Hbn.

White Point Beach, August 1, 1935; Digby, August 8, 1908; Coldbrook, Kings County, June 5, 1949; MacNab's Island, July 2, 1905; Prospect Road, Halifax County, July 12, 1951; Debert June 13, 1952; Rare. Larva on species of *Vaccinium* (Dyar, *Insect Life*, Vol. 3, p. 391).

1160 *A. grisea* Wlk.

Many localities from White Point Beach and Digby to Baddeck. Often very plentiful at light, June 10 - August 25. Bred several times from larvae on alder, found also on Willow and once on apple. Larva bright translucent green, sparsely hairy, with brown saddle-like markings on dorsum.

1168 *A. funeralis* G. & R. Plate IV, Figure 5.

Round Hill, July 29, 1940; Wolfville, bred from larva on Willow; MacNab's Island, July 29, 1916, and bred June 20, 1907. Rare. The larva presents a very striking appearance, and the following description was made from the Wolfville specimen. Dull coal black, naked of hair, with a vivid orange, transversely elongate dorsal patch on each abdominal segment, similar but smaller markings on the thoracic segments. Within each patch of orange there is a black bar, from the ends of which arise a pair of long, lustrous black, blade-shaped, chitinous tubercles that wave in the air as the larva crawls. The first thoracic segment has two pairs of these compressed, filamentous tubercles. Head shining black; spiracles small, intensely black dots.

1172 *A. vinnula* Grt.

Great Village, Colchester County, no date (A. D. Hall). Specimen sent by Mr. Hall to Dr. T. N. Freeman, who determined it. Elm.

1173 *A. superans* Gn.

Digby, Lequille, Bridgetown, Isle Haute, Armdale, MacNab's Island, June 5 - August 10. Occasionally common at bait. Plum, apple, birch, mountain ash (Smith and Dyar).

1174 *A. laetifica* Sm. Plate IV, Figure 6.

Lequille, Annapolis County, June 14 - July 27; Glenholme, June 5, 1952; Three Brooks, Pictou County, July 20, 1944. Infrequent, and apparently local.

1175 *A. furcifera* Gn. Plate IV, Figure 7.

Chignecto, Waverley, Dartmouth, Lequille, Digby. July 21 - 28. Scarce. Wild cherry.

1181 *A. morula* G. & R.

Digby, Annapolis and Petite Riviere north to Three Brooks, Pictou County, and Baddeck. Local, and commonest in Annapolis County. June 15 - August 10, at light and bait. Elm, apple, linden.

1182 *A. interrupta* Gn.

Lequille, Armdale, MacNab's Island. June 29 - August 12. Locally common at light and bait. Elm, apple, plum, birch.

1183 *A. lobeliae* Gn. Plate IV, Figure 9.

Digby, July 29, 1905; Annapolis Royal, July 27, 1946, at light; Lequille, July 28, 1946, at bait. Rare. Oak.

1185 *A. fragilis* Gn.

White Point Beach, Lequille, Mount Uniacke, Armdale, MacNab's Island, Baddeck. June 20 - August 2. Bred specimens seen from *Betula lutea* and *populifolia*. Also has been reported on apple and mountain ash.

1191 *A. inclara* Sm. Plate V, Figure 3.

Acaciaville, Digby, Annapolis, South Milford, vicinity of Halifax, Baddeck. June 13 - August 10, usually at bait. Commonest in beech woods.

1193 *A. hamamelis* Gn. Plate V. Figure 2.

Annapolis Royal, Lawrencetown, Centreville, vicinity of Halifax, Glenville, Three Brooks. June 11 - August 10, at light and bait. Usually more plentiful than *inclara*. Occasional melanic specimens occur. Bred at Annapolis from red oak, and has been reported also on birch.

1195 *A. retardata* Wlk.

White Point Beach and Digby to Baddeck. June 14 - August 9. Regularly, though sparingly, at light. Maple.

1197 *A. subochrea* Grt. Plate IV, Figure 10.

Digby, June 20, August 2, 1907; Lequille, July 29, August 6, 1946, at light and bait. Rare. Have found larvae on witch-hazel that I presumed to be this species, perhaps erroneously.

1198 *A. afflicta* Grt. Plate V, Figure 1.

Lequille, Annapolis County, June 26, 1946, at bait. One specimen. Petite Riviere, Lunenburg County, July 17, 1953; one specimen at light. Dr. Frank Morton Jones reports the larvae on oak on Martha's Vineyard.

1201 *A. impleta* Wlk.

Various points through the Annapolis Valley from Digby and Annapolis to Centreville, and at White Point Beach, Queens County and Armdale. I have seen it quite common at bait in deciduous woods near Armdale. May 26 - July 21. Bred from larvae on poplar at White Point Beach (McDunnough), and on Willow at Annapolis Royal. Larvae also on white and yellow birch.

1202 *A. sperata* Grt.

Digby, Annapolis, Round Hill, Mason's Point, Halifax County, Truro, Stellarton, Chignecto. June 16 - July 8. Scarce. Poplar, alder.

1203 *A. noctivaga* Grt.

Annapolis Valley region from Digby and South Milford through Mount Uniacke to Halifax, and at Great Village and Baddeck. May 26 - August 16, with a straggler September 3. Sometimes relatively plentiful at bait in June. Poplar.

1204 *A. impressa* Wlk.

Digby and Lequille through the Annapolis Valley region to Halifax, at Caledonia, Queens County and north to Three Brooks and Stellarton, Pictou County. Locally common. May 9 - August 28. Larvae on willow.

1209 *A. lithospila* Grt.

Annapolis Royal, Armdale, Mason's Point, Halifax County. July 7 - August 26. Larva green with brown dorsal markings, sparsely clothed with black hairs; on red oak at Annapolis.

1215 *A. oblinita* A. & S.

White Point Beach and Acaciaville to Baddeck. Generally distributed and common. June 12 - August 7. Larvae conspicuous on willow, alder, *Myrica gale*, *Spiraea* and other meadow vegetation in the fall, always heavily parasitized.

1216 *A. lanceolaria* Grt. Plate IV, Figure 8.

Armdale, July 14, 1948 and Mount Uniacke, June 22, 1951, at light; bred May 7, 1947 from a larva on *Alnus crispa* at Granville Ferry; May 6, 1953 from a larva on *Kalmia polifolia*, Prospect Road area; also bred from a larva on bayberry at Smith's Cove, Digby County, and on May 28, 1948 from a pupa found under a log near Armdale. Very rare, or else not readily taken as an adult by the usual collecting procedures. Larva thick and chunky with blackish skin, and many large, bright yellow tubercles bearing tufts of stiff yellow hair. The dark skin and yellow tubercles are conspicuous features. Reported on Willow, *Comptonia* and *Gaillardia* by Smith and Dyar.

Simyra Ochs.

1222 *S. henrici* Grt.

Annapolis Royal, Round Hill, Lawrencetown, Auburn, Aylesford, Wolfville, Debert, Great Village, Goodwood, Halifax County. Two broods, June 6 - July 23, and August 10 - 30, including form *fumosa* Morr. in both generations. Seems to have an association with marshes. Smith and Dyar list grass, smartweed and willow as food plants.

Harrisimemna Grt.

1223 *H. trisignata* Wlk.

Taken many times in the southern portion of the province from White Point Beach and Annapolis to Cole Harbour and Truro. None from farther north or east, though probably occurs there. June 15 - August 14, at light. The grotesque larva reported on lilac at Digby (Russell), and at Mount Uniacke in 1950 I found and reared to maturity a larva on *Viburnum cassinoides*. The repeated occurrence of the moth in such situations where *Viburnum* grows abundantly leads me to suspect that this is the natural food plant throughout this region.

Agrontinae

Euxoa Hbn.

1272 *E. detersa* Wlk. Plate V, Figure 4.

Walker, 1856. Cat. Lep. Het. Brit. Mus., pt. 9, p. 212.
Type locality: Nova Scotia.

Cole Harbour, Halifax County, August 31, 1951 (Harrington); Peggy's Cove, September 18, 20, 1952; Aylesford, August 26, 1952; Stellarton, no date. Although described from here, *detersa* seems to be quite rare. In abundance once only, at Petite Riviere, September 4, 1953.

1292 *E. perpolita* Morr. Plate V, Figure 5.

Auburn, Aylesford, Coldbrook, Centreville, Great Village, Peggy's Cove, Port Wallis, Bedford, Prospect Road, Halifax County, and White Point Beach. August 11 - September 22. Locally common, most specimens coming from coastal localities or the heath country of the Annapolis Valley. Occasional examples show distinct traces of the brown suffusion that characterizes the variety *criddlei* Sm.

1296 *E. velleripennis* Grt.

From Digby and Lequille through the Annapolis Valley, and at Cole Harbour, Truro, Stellarton and Cape North. August 23 - September 19; July 12 at Cape North. Taken more frequently than *perpolita* but never abundant.

1297 *E. scandens* Riley.

Auburn, White Point Beach, Petite Riviere, Armdale, MacNab's Island, Debert. June 30 - August 20. The records suggest that it may occur only in the southern part of Nova Scotia.

1309 *E. mimallonis* Grt. Plate V, Figure 6.

Digby, September 17, 1907 (in the Nova Scotia Museum of Science collection); Prospect Road, Halifax County, August 29, 1951, and farther out the same road at Shad Bay, July 29, 1952. Rare.

1310 *E. messoria* Harr.

Many records, from White Point Beach and Digby north to Parrsboro, Springhill and Stellarton including, less commonly, form *atrifera* Grt. August 9 - October 3, at light and bait. Often abundant, and probably one of the major cutworms.

1315 *E. scholastica* McD. Plate V, Figure 7.

Lequille, White Point Beach, Shad Bay, Armdale and Stellarton. July 16 - August 27. Local and usually scarce. Taken in series at White Point Beach by Dr. McDunnough, and I had four come to light one evening near Shad Bay.

1321a *E. ontario vestitura* Sm. Plate V, Figure 8.

Digby, Annapolis, White Point Beach, Petite Riviere, north to Parrsboro, Stellarton, Baddeck and Margaree Forks, Victoria County. Almost as common as *messoria*. July 22 - October 3, at light—most of the records in August. Strongly attracted to honeydew from aphids on birch, though seemingly not to the conventional bait mixtures. Described from Saint John, N. B.

1341 *E. tessellata* Harr.

White Point Beach, Centreville, July 23 - August 7. Rare.

1351a *E. declarata decolor* Morr.

Digby, Auburn, Aylesford, Coldbrook, Bridgewater, Armdale, Cole Harbour, Parrsboro, Stellarton. August 10 - September 15. Not common.

1352 *E. campestris* Grt.
Bridgetown (G. E. Sanders). In the Canadian National Collection.

1354 *E. albipennis* Grt. Plate VI, Figure 1.
Auburn, Kings County, September 1, 1951. One male at light.

1366 *E. divergens* Wlk. Plate V, Figure 9.
Walker, 1856. Cat. Lep. Het. Brit. Mus., pt. 10., p. 327.
Type locality: Nova Scotia.

South Milford and Lequille, Annapolis County, Auburn, Kings County, Mason's Point and Bog, Prospect Road, Halifax County, Stellarton, Pictou County, June 27 - July 22, mostly in late June. Locally common. Walker's types, from Lieut. Redman's collection, might have come from the vicinity of Halifax.

1371 *E. redimicula* Morr.
Coldbrook, Kings County, August 31, 1951. Four specimens, examined by Dr. McDunnough. The Nova Scotian record for this species given by Dr. McDunnough in his revision of the Eastern *Euxoas* (Bulletin A.M.N.H., Vol. 95, Article 6, p. 391, 1950) was based on specimens that I had misdetermined, and should have been referred to *novangliae* McD.

1371,la *E. servita novangliae* McD.
Digby, Annapolis, Round Hill, Coldbrook, Centreville, July 11 - August 12. Seems restricted to the Annapolis Valley region, where it is much more prevalent than the closely allied *redimicula.*

1378 *E. ochrogaster* Gn.
White Point Beach, Digby, Annapolis, Bridgetown, MacNab's Island, Cole Harbour, Parrsboro, Glenville, Pictou. July 23-August 28, mostly at bait. The pale form *insignata* Wlk. (Cat. Lep. Het. Brit. Mus., pt. 10, p. 330. 1856. Type locality: Nova Scotia), and the deep reddish-brown form *gularis* Grt. occur occasionally, also an unnamed form similar to *gularis* but lacking the black dash.

1382 *E. tristicula* Morr. Plate V, Figure 10.
Annapolis Royal, June 27, 1930, July 22, 1924; Round Hill, Annapolis County, June 20 - July 9, at light. Includes the form with obsolete black markings (*nesilens* Sm.). *E. tristicula* is one of those species that is very rare in the east, but common in the West.

Agrotis Ochs.

1416 *A. vetusta* Wlk.
Walker, 1856. Cat. Lep. Het. Brit. Mus., pt. 9, p. 78, as *Mythimna vetusta.*
Type locality: Nova Scotia.

White Point Beach, MacNab's Island, Stellarton. July 23 - August 28. Scarce.

1419 *A. mollis* Wlk. Plate V, Figure 11.
Lequille, Annapolis County, July 25, 1949. One specimen at light; Stellarton, three specimens without date (Hills collection). Rare.

1422 *A. gladiaria* Morr. Plate V, Figure 12.
Armdale, September 16, 1947, one specimen at light.

1425 *A. venerabilis* Wlk.

Walker, 1856. Cat. Lep. Het. Brit. Mus., pt. 10, p. 328.
Type locality: Nova Scotia.

Lequille and Granville Ferry to Great Village, Truro, Stellarton and the vicinity of Halifax. Often abundant. August 30 - September 22, at light.

1432 *A. volubilis* Harv.
Much less common than the preceding. Digby, Annapolis, Round Hill, Greenwood, Armdale, Peggy's Cove, Stellarton. June 3 - 28, at light.

1435 *A. ypsilon* Rott.
One of the most abundant moths everywhere. April 8 - November 2, most frequently at bait. A notorious cutworm.

Feltia Wlk.

1442 *F. ducens* Wlk. Plate VI, Figure 2.
Common from Digby and Annapolis Royal through the Annapolis Valley to Grand Pré, also at Stellarton and Trenton, Pictou County; Otherwise taken only at Petite Riviere and Cole Harbour. Seems confined essentially to the sedimentary rock areas in the western sections of the Province. August 12 - September 11. This is the type of the genus *Feltia*.

1445 *F. subgothica* Haw.
Armdale, August 15, 1950—the only specimen seen.

1446 *F. herilis* Grt.
Records from Digby and White Point Beach to Cole Harbour and Trenton. July 14 - September 13. By far the commonest *Feltia*, and probably present throughout the area.

1450 *F. annexa* Treit.
Armdale, September 4, 1944; Sackville, Halifax County, August 22, 1950. Rare and possibly a migrant.

1451 *F. geniculata* G. & R.

Deerfield, Yarmouth County, Lake Rossignol and White Point Beach to Debert, Armdale and Herring Cove. July 13 - August 31, at light. Occurs commonly on bogs, but by no means confined to this habitat.

Actebia Steph.

1452 *A. fennica* Tausch.

Digby, Armdale, MacNab's Island, Cole Harbour. August 8 - September 14, usually at bait. Rather rare.

Spaelotis Bdv.

1472 *S. clandestina* Harr.

Digby and White Point Beach to Cole Harbour, Truro and Parrsboro. Presumably general, since it occurs well to the north in New Brunswick. July 4 - September 12, at light.

Eurois Hbn.

1475 *E. occulta* Linn.

Digby, Bridgetown, Mount Uniacke, various points in Halifax County, and Lakelands, Cumberland County. Probably general. July 30 - September 3, at bait.

1476 *E. astrica* Morr.

Digby, Mount Uniacke bogs, Armdale, Debert, Glenville, Baddeck. July 28 - August 29, at light and bait. Local, but often commoner than *occulta.*

Ochropleura Hbn.

1480 *O. plecta* L.

Digby and White Point Beach to Truro, Cole Harbour and Baddeck. June 24 - August 5, and one at Grand Pré., August 28. Sometimes quite common at light.

Euagrotis McD.

1483,1 *E. forbesi* Franclemont. Plate VI, Figure 10.

Debert, Colchester County, July 15 and 21, 1952 (W. Harrington).

Metalepsis Grt.

1493 *M. fishi* Grt. Plate VI, Figure 3.

Halifax watershed area, Armdale, MacNab's Island, Hammond's Plains. Halifax County, Wellington, Mount Uniacke, Aldershot. May 1 -

June 11, mostly in early May. A total of little more than a dozen specimens taken. Usually regarded a rare species wherever it occurs.

1494 *M. salicarum* Wlk.

Round Hill and Middleton through Mount Uniacke to the vicinity of Halifax, at Caledonia, Queens County and northward to Great Village and Stellarton. Locally common at light, bait and willow catkins. April 13 - May 26.

Peridroma Hbn.

1496 *P. margaritosa* Haw.

Generally distributed and always one of the most abundant moths at bait, including form *saucia* Hbn. Throughout the season from April to November, but most plentiful in the fall. Bred August 25 from a larva that fed on grass.

Hemipachnobia McD.

1497 *H. monochromatea* Morr. Plate VII, Figure 3.

South Milford, Annapolis County, Mount Uniacke, Port Wallis, bogs in the Prospect Road area and at Peggy's Cove, and Baddeck. June 8 - July 19, at light. Strictly a bog species, usually common in suitable habitats.

Paradiarsia Pack.

1498 *P. littoralis* Pack.

Lawrencetown, Annapolis County, July 13, 1945. One specimen. Stellarton, Pictou County, series without data (Hills Coll.).

Pseudospaelotis McD.

1499 *P. haruspica* Grt.

Various localities from Digby through the Annapolis Valley, and in Halifax and Pictou Counties. Probably generally distributed. July 18 - August 10. Common at light and bait.

Caradrina Ochs.

1500 *C. quadrangula* Zett. Plate VI, Figure 4.

Shad Bay, Halifax County, July 29, 1952, one female at light. Another specimen, possibly from Stellarton, Pictou County, but lacking data, from the C. B. Hills collection. In the *Catalogue of Noctuidae* (Bulletin 44, U.S.N.M.) J. B. Smith gives Labrador and Nova Scotia as the habitat of *Noctua rava* H.-S. (the name *rava* having fallen to the synonymy of *quadrangula*), so there seems to have existed a previous record of its occurrence here.

Since this was written, there have been added two more records taken at light on the barrens near Peggy's Cove, July 11 and September 8, 1953.

Heptagrotis Mc.D.

1502 *H. phyllophora* Grt.

Barrington Passage, White Point Beach and Digby to Baddeck. June 15 - August 3, at light. Usually abundant, both in bogs and dry woodland.

Diarsia Hbn.

1504 *D. cynica* Sm.

White Point Beach and Digby north to Glenville, Cumberland County, but probably general. July 23 - September 3, at light and bait. Often abundant, varying from deep smoky brown specimens to bright reddish ones, but all are alike genitalically. After an extensive study of the group, I am inclined to believe that *cynica* is identical with *rubifera* of Grote, in which case the latter name would have priority, antedating Smith's name by twenty-three years.

1507 *D. jucunda* Wlk.

Digby, Lequille, Coldbrook, Bass River, Pictou, Baddeck and various points in Halifax County. July 9 - August 10, at light. Moderately common. Highly variable in coloring and maculation, but even the most extreme forms show no noticeable differences in genitalia of the males. Bog specimens are especially dark.

1510,1 *D. pseudorosaria* Hardwick, race *freemani* Hdwk. Plate VI, Figure 6.

Digby, July 1, 1907 (J. Russell). A single male, determined by genitalia. The record may be considered authentic. The only specimen I have taken personally came to light in the spruce forest at three thousand feet in Jefferson Notch, N. H.. Eastern race *freemani* was described from Labrador.

Graphiphora Ochs.

1511 *G. c-nigrum* Linn.

Widely distributed and common, especially at bait. June 12 - September 22. Most plentiful in late summer and fall.

1512 *G. smithi* Snell.

Records from White Point Beach and Digby north to Glenville Cumberland County, but probably throughout. Abundant at bait, August - September 27.

1513 *G. normaniana* Grt.

Distribution similar to the above. Also an abundant species. July 23 - August 26.

1517 *G. oblata* Morr. Plate VI, Figure 5.

Mount Uniacke bog, July 9, 1947, July 18, 1946, at light; Halifax watershed area, July 6, 1951, two specimens at light. I have found it more commonly in boggy areas of north-eastern New Brunswick.

1522 *G. collaris* G. & R.

Numerous records for the Annapolis Valley region from Digby to Grand Pré; elsewhere only at Armdale, Debert and Parrsboro. August 19 - September 17. Scarce.

1523 *G. bicarnea* Gn.

White Point Beach, Digby, Lequille, Bridgetown, Truro and near Halifax. July 21 - September 3. Common at bait.

1525 *G. tenuicula* Morr.

Digby, September 3, 1907; Lequille, July 24, 1949; Parrsboro, August 17, 1944. Rare.

1527 *G. opacifrons* Grt.

Bogs at Mount Uniacke, Peggy's Cove, Herring Cove, and the Prospect Road area near Halifax, and at Aylesford and White Point Beach. Restricted to bogs, where it may be taken in abundance at light and bait during the flight period. Larvae on *Chamaedaphne* and other bog plants in the spring.

Anomogyna Staud.

1555 *A. perquiritata* Morr. Plate VI, Figure 7.

White Point Beach, Digby, Stellarton, Mount Uniacke, vicinity of Halifax, North Mountain, Cape Breton. August 1 - 23, at light. Not uncommon at Goodwood and on the Mount Uniacke bogs, where it came to light in greatest numbers on cool, foggy nights. Larvae on larch and spruce.

1558 *A. imperita* Hbn. Plate VI, Figure 8.

Mount Uniacke bog, August 11-18, 1950 (forty specimens); Prospect Road, Halifax County, August 13, 1951 (one specimen). They came to the lights most frequently when the nights were cold, with the temperature below 50°—too cold for most other species to fly at that time of year. *Imperita* actually seemed less active on the warmer nights when other moths were plentiful. Otherwise known in the east only from Labrador and near timber line in the Appalachians of New England. Little is known of the early stages.

1561 *A. elimata* Gn.

Digby, Annapolis, Lake Rossignol, Coldbrook, Auburn, Mount Uniacke, and various localities in Halifax County. July 14 - September

20, at light. Moderately common. The population is strikingly variable, but so far efforts to split it into more than one species have not ended satisfactorily. On fir, and probably conifers generally.

1562 *A. dilucida* Morr.

Digby, Bridgetown, Auburn, Aylesford, Mount Uniacke, and the vicinity of Halifax. Abundant at both light and bait in Halifax County, including form *youngi* Sm. August 13 - October 9. No doubt more widely distributed but missed through lack of more extensive collecting at that time of year. Bred from a larva on larch, and probably feeds also on other conifers. Bred also from larvae on Kalmia (McDunnough).

Aplectoides Butl.

1568 *A. condita* Gn. Plate VI, Figure 9.

White Point Beach, South Milford, Mount Uniacke, Cheticamp River Valley, and McNab's Island, Waverley, Port Wallis, Armdale and Goodwood near Halifax. June 15 - July 30, at light. Widely distributed but scarce. Bred from Balsam Fir by the Canadian Forest Insect Survey.

Anaplectoides McD.

1569 *A. pressus* Grt.

White Point Beach, Digby, Acaciaville, Centreville, Mount Uniacke, Armdale, MacNab's Island, Baddeck. June 30 - August 15, at light. A species characteristic of the northern spruce forest.

1570 *A. prasina* Schiff.

Annapolis, Centreville, Mount Uniacke, Armdale, Shad Bay, MacNab's Island, Baddeck. July 15 - August 16, at light and bait. Locally common.

Protolampra McD.

1571 *P. rufipectus* McD.

Digby, August 29, 1907, one specimen (J. Russell); Aylesford, August 26, 1952, two worn specimens at bait; Debert, August 6, 1952; Baddeck, August 18, 1928 (G. P. Engelhardt).

Cryptocala Benj.

1575 *C. acadiensis* Beth. Plate VII, Figure 1.

Bethune, Trans. N. S. Inst. Science, Vol. 2, pt. 3, pp. 84-85, 1869; republished in the Can. Ent., Vol. 2, p. 64, 1870. Type locality: "Ashbourne, near Halifax" (The name *Ashbourne*, changed to *Ashburn*, survives now as the name of a golf course, within the district of Armdale).

White Point Beach and Digby north to Glenville, Cumberland County, Pictou and Baddeck. No doubt general. July 23 - August 18, at light and bait. Often abundant.

Eueretagrotis Sm.

1577 *E. perattenta* Grt.

Digby, White Point Beach, Petite Riviere north to Great Village and Baddeck, though presumably general. Quite common. June 27 - July 30, at light.

1578 *E. attenta* Grt.

Shelburne, White Point Beach, Peggy's Cove, Armdale, Waverley, Centreville, Glenville. July 8 - August 5, at light. Scarcer than *perattenta* but by no means rare.

Abagrotis Sm.

1601 *A. alternata* Grt.

Digby, Auburn, Armdale. July 27 - September 11, at bait. Locally common. Variable in coloration but apparently all one species.

Rhynchagrotis Sm.

1602 *R. cupida* Grt.

Digby, Lequille, Bridgetown, Auburn, Aylesford, Mount Uniacke, Waverley, MacNab's Island. July 29 - September 2, at light and bait. Not very common. Quite variable, and probably inculudes form *brunneipennis* Grt.

————*Rhynchagrotis* sp.

An undetermined species with smooth looking, rich red-brown primaries, sometimes suffused with smoky brown. The usual maculation, including the dark scaling of the reniform and orbicular, obsolete. The male genitalia show readily observed differences from those of *cupida*. Centreville, Armdale, Peggy's Cove, MacNab's Island, July 26-August 29. Scarce.

Ufeus Grt.

1611 *U. satyricus* Grt.

Granville Ferry, Round Hill, MacNab's Island, Waverley, Truro. August 12-November 30, and March 3 - April 25. Evidently emerges in the fall and hibernates. In spruce and fir areas, but seems to be rare.

Hadeninae

Scotogramma Sm.

1633a *S. trifolii albifusa* Wlk. Plate VI, Figure 11.

Walker, Cat. Lep. Het. Brit. Mus., pt. XI, p. 753, 1857.
Type locality: Nova Scotia.

White Point Beach and Digby north to Parrsboro, Pictou and Baddeck. May 24 - August 26. Rarely common, though widely distributed. Some dark specimens, resembling normal *trifolii* Rott., also occur.

Mamestra Ochs.

1661 *M. curialis* Sm. Plate VI, Figure 12.
MacNab's Island, June 28, 1906; Truro, July 8, 1927.

Polia Ochs.

1663 *P. nimbosa* Gn.
Digby, Centreville, Armdale, MacNab's Island, Three Brooks, Pictou County, July 16 - August 18, at light. Locally common.

1667 *P. imbrifera* Gn.
White Point Beach, Digby, Armdale, MacNab's Island, Great Village, Pictou. July 4 - August 6, at light and bait. Commoner than *nimbosa.*

1669 *P. purpurissata* Grt.
Digby, White Point Beach north to Springhill and Pictou. Probably general. July 13 - September 5, at light. Often abundant. Bred from a larva on birch; reported on sweet fern, blueberry, *Spiraea*, Rhodora, etc.

1672 *P. grandis* Bdv.
Digby, Annapolis, Auburn, Mount Uniacke, scattered points in Halifax County, Glenholme, Baddeck. June 8 - July 18. Moderately common.

1673 *P. subjuncta* G. & R.
Digby, Annapolis, Centreville, Armdale and Mason's Point, Halifax County. June 25 - August 10, at light and bait. Seems to be in the southern counties only. Reported on blueberry.

1675 *P. latex* Gn.
Digby and vicinity, Annapolis, South Milford, Round Hill, Centreville, Mount Uniacke, Armdale, MacNab's Island, Baddeck. May 26 - June 30. Occurs sparingly. Two examples from Annapolis are melanic. On various deciduous trees.

1677 *P. atlantica* Grt.

Digby, Petite Riviere north to Great Village, Pictou and Baddeck. Undoubtedly general. June 3 - July 31. Sometimes abundant at light. Bred from mountain ash by the Canadian Forest Insect Survey.

1679 *P. radix* Wlk.

Digby, June 17, 1907; Baddeck, June 21, 1936. Rare.

1683 *P. legitima* Grt.

Many records from White Point Beach and Lequille to Baddeck and Cheticamp. Moderately common. June 7 - August 31.

1684 *P. tacoma* Stkr. Plate VIII, Figure 1.

Digby, Auburn, Greenwood, Aldershot,Truro, Great Village, Baddeck. June 4 - 30. Not common. Sometimes hard to distinguish from *legitima*, but the records given are of fairly well defined examples. *Tacoma* tends to be larger, with the dark brown suffusion of the basal and median areas contrasting sharply with the smooth, blue-gray postmedian shade. Also the course of the t. p. line is a little straighter than in *legitima* and less dentate.

1685 *P. rugosa* Morr. Plate VII, Figure 4.

Bogs at Mount Uniacke, in the Prospect Road area, Halifax County, Armdale, Peggy's Cove. June 8 - July 18. Also seen from Stellarton. Rarely strays far from its bog or muskeg habitat, where it is sometimes quite abundant at light. Presumably present in suitable locations throughout this region.

1687 *P. lilacina* Harv.

Lawrencetown, Auburn and Greenwood in the Annapolis Valley; Halifax County, Truro, Glenholme, Baddeck, Cheticamp. June 12 - July 17, at light. About fifty percent are referable to the more unicolorous form *illabefacta* Morr.

1691 *P. adjuncta* Bdv.

White Point Beach, Annapolis to Springhill and Baddeck. Common. June 12 - August 4, at light. Has been variously reported as feeding on braken fern, *Solidago* and elm, perhaps partly in error.

1693 *P. assimilis* Morr.

White Point Beach, Digby, Lequille to Great Village, Pictou and Baddeck, in moderate numbers. June 10 - August 10, at light. Bred at Wolfville from a green and yellow striped larva on *Comptonia*. The Canadian Forest Insect Survey bred it from white birch at Ingonish. Also reported on alder and ash.

1694 *P. pulverulenta* Sm. Plate VII, Figure 6.

Mount Uniacke bog, July 18, 1946; MacNab's Island, June 30, 1914; Mason's Point, Halifax County, July 7, 1945; Debert, July 17, 1952; Glenholme, June 26, 1952; Great Village, no date. All just single specimens, at light. Larch.

1696 *P. ingravis* Sm. Plate VIII, Figure 3.

Bogs at Mount Uniacke and on the Prospect Road, Halifax County. Halifax watershed area, Peggy's Cove, Glenholme, Great Village. June 5 - July 2, with one late record August 4 (Great Village). Found commonly only on the barrens near Peggy's Cove. Larva on willow in the west, where the species is better known.

1697, 1 *P. frustrata* McD. Plate VIII, Figure 2.

Halifax watershed area, June 20, 1951; Bog, Prospect Road, July 2 1951; MacNab's Island, June 9, 1909; Cole Harbour, May 23, 1951 (W. Harrington); Mount Uniacke, June 7, 1950, June 10, 1953, June 22, 1951. Rare. Bred from larvae on larch in Newfoundland (the types) and at Elmsville, Charlotte County, N. B. (Canadian Forest Insect Survey). Also seen from Maine (the Brower collection).

1699 *P. lutra* Gn.

White Point Beach, South Milford, Annapolis north to Springhill and Baddeck. Common. June 10 - August 17. Larva on birch (Canadian Forest Insect Survey).

1709 *P. detracta* Wlk.

Annapolis, South Milford, Centreville, Mount Uniacke, vicinity of Halifax, Great Village, Baddeck. June 22 - July 23, at light and bait. Sometimes abundant. Reported on *Amelanchier*, gray birch, blueberry.

1710 *P. goodelli* Grt.

Lequille, Annapolis County, June 12, July 24, 1949; Acaciaville, June 29, 1951; Halifax, July 5, 1945. Seemed common in the Annapolis County locality, but evidently very local.

Lacinipolia McD.

1712 *L. meditata* Grt.

Lequille, Lawrencetown, Auburn, White Point Beach, Debert. July 15 - August 27, mostly at bait. Locally common.

1714 *L. lustralis* Grt.

Digby, Annapolis, South Milford, Round Hill, Auburn, and near Halifax. June 14 - July 15, at light. Not common. Seems more plentiful northward in New Brunswick.

1716 *L.* *anguina* Grt.

Annapolis, Greenwood, Auburn, Coldbrook, Mount Uniacke, Prospect Road, Peggy's Cove, Armdale. June 1 - 30. Scarce everywhere except on the barrens at Peggy's Cove, where it came to light in numbers.

1738 *L.* *renigera* Steph.

Occurs quite commonly everywhere. July 4 - September 4, at both light and bait. Recorded as feeding on chicory (*Papilio*, Vol. 3, p. 133).

1744 *L.* *lorea* Gn.

Digby, Annapolis, Bridgetown, Stellarton and the vicinity of Halifax, though probably present everywhere. June 17 - July 29, at light. Common.

1745 *L.* *olivacea* Morr.

White Point Beach, Digby to Parrsboro and Pictou. Common locally at light and bait in the Annapolis Valley and Cumberland County Scarcer elsewhere. July 31 - August 31.

Lasionycta Auriv.

———— *Lasionycta* sp., undetermined.

Bog near Mount Uniacke, July 9, 1947; Baddeck bog, July 1, 1949, at light. Two specimens only. Also taken at Bartibog, north of Chatham, N. B., July 9, 1950, and one seen from Maine (Brower coll.). Differs from *membrosa* Morr. from New Hampshire in being considerably larger and darker.

Anarta Ochs.

1789 *A.* *cordigera* Thun. Plate VII, Figure 2.

Bog on the Prospect Road, Halifax County, June 7 - 9, 1951; series of twenty taken at flowers of *Andromeda glaucophylla.* Mount Uniacke bog, June 18, 1948, one worn female. Darts about in bright sunlight with a rather bee-like flight, but is readily netted when feeding. Larva on *Vaccinium* and *Arctostaphylos uva-ursi* in Europe.

Sideridis Hbn.

1800 *S.* *rosea* Harv. Plate VIII, Figure 5.

Digby, June 21, 1905, June 25, 1907; Aylesford, Kings County, June 3, 1951; Auburn, Kings County, June 2, 1953.

1801 *S.* *congermana* Morr. Plate VIII, Figure 6.

MacNab's Island, July 23, 1907; Stellarton, no date.

1802 *S. maryx* Gn.

Digby, Auburn, Mount Uniacke, Armdale, Prospect Road, MacNab's Island, Peggy's Cove, Cole Harbour, Debert, Baddeck. June 6 - July 17, at light. Not common.

Tricholita Grt.

1821 *T. signata* Wlk.

Including the form without a white reniform, *igna* B. & B. Acaciaville, White Point Beach, Mount Uniacke, Sackville, Armdale, MacNab's Island, Peggy's Cove, Stellarton. July 26 - August 28, at light. Common.

Protorthodes McD.

1855 *P. oviduca* Gn.

Digby, Annapolis, Aldershot, Armdale, Cole Harbour. June 2 - July 3; Local and not very common.

Orthodes Gn.

1871 *O. crenulata* Butl.

White Point Beach, Digby and Lequille to Glenville, Cumberland County and Truro; probably more general northward but overlooked. June 30 - August 15, at light and bait. Occasionally abundant.

1872 *O. cynica* Gn.

Digby and Lequille through the Annapolis Valley to Halifax, and at Baddeck. Probably everywhere. June 5 - July 8, at light and bait. Abundant.

Pseudorthodes Morr.

1876 *P. vecors* Gn.

Including the form with a white reniform, *nitens* Grt. White Point Beach, Digby, Lequille, Lawrencetown, Centreville, Petite Riviere, Truro and the vicinity of Halifax. June 8 - August 4, at light. Not especially common.

Homorthodes McD.

1890 *H. furfurata* Grt.

Digby, July 29, 1905; South Milford, June 27, 1951; Lawrencetown, Annapolis County, July 15, 1945; Centreville, July 26, 1950; Armdale, July 17, 27, 1945, at light and bait. Scarce.

Nephelodes Gn.

1895 *N. emmedonia* Cram. The Bronzed Cutworm.

Generally distributed and abundant throughout the mainland of Nova Scotia. Not seen from Cape Breton, but should certainly be present there as well. August 4 - October 9 at light and bait. The larva is most likely a general feeder on herbaceous plants, including *Gramineae*.

Morrisonia Grt.

1903 *M. evicta* Grt.

Digby, Aldershot, Mount Uniacke, Bridgewater, Armdale. Sometimes quite common at bait in the spring. May 7 - June 8. Examples of form *vomerina* Grt. form about half the population.

1904 *M. confusa* Hbn.

Smith's Cove, Digby County, May 17, 1953; Bridgewater, May 28, 1950; Caledonia, Queens County, May 15, 1951; Lake Kejimukujik, Queens County, in beech woods, May 29, 30, 1950, at light. Local. The Canadian Forest Insect Survey records as food plants: basswood, cherry, chestnut, ironwood, maple and poplar.

Xylomyges Gn.

1914 *X. dolosa* Grt. Plate VIII, Figure 4.

Aldershot, May 11, 1950; Waverley, May 22, 1949; Armdale, May 27, 30, 1948, May 24, 1950, all single captures at light. In the Halifax watershed area, May 7 and 9, 1951, I encountered this species in excessive abundance, and after selecting a series of about one hundred of the very best specimens, many hundreds more still remained on the sheets. In the same locality, April 22 - 26, 1952, it was again common, though not to the same extent as the previous year. A very few came to bait both seasons. Apparently one brood only. Food plant: poplar.

Orthosia Ochs.

1937 *O. rubescens* Wlk. Plate VIII, Figure 7.

Digby County, Waverley, Armdale, April 10 - May 22. Rarest of the three *Orthosias*. Bred from a larva on beech (Digby County) by the Canadian Forest Insect Survey.

1940 *O. revicta* Morr.

Round Hill, Aldershot, Caledonia, Mount Uniacke, Waverley, vicinity of Halifax, Three Brooks, Pictou County. One of the commonest early spring species at bait. April 10 - May 27, with a straggler July 4. Extremely variable in coloration. A general feeder on deciduous trees.

1943 *O. hibisci* Gn.

Greenwood, Kings County, Armdale, MacNab's Island, Great Village. April 2 - May 24, at bait. Usually less common than *revicta* but occasionally more so. Also a general feeder on deciduous forest trees.

Crocigrapha Grt.

1950 *C. normani* Grt.

Digby, Aldershot, Centreville, Mount Uniacke, Armdale, MacNab's Island, Isle Haute, off Cape Chignecto. May 4 - June 21, at bait. Common. Larva on deciduous trees generally.

Ceramica Gn.

1951 *C. picta* Harr.

Acacia Valley, Lequille, Greenwood, White Point Beach, MacNab's Island, Debert, Glenholme. June 5 - August 25, at light .Adults rather scarce but larvae sometimes too plentiful, feeding on most garden plants. Has been recorded as a garden pest (H. G. Payne, Proceedings N. S. Ent. Soc., 1917, No. 3, pp. 44-49).

Protoleucania McD.

1962a *P. albilinea diffusa* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 9, p. 94, 1856. Type locality: Nova Scotia.

Acaciaville and Annapolis to Armdale, and northward to Three Brooks, Pictou County and Baddeck. May 27 - July 4, and July 27, August 28, at light. Moderately common. Larva on grasses.

Leucania Curt.

1973 *L. pseudargyria* Gn.

Acacia Valley, Digby County and Annapolis Royal. July 21 - August 1, at light and bait. Common in the vicinity of Annapolis. The larvae of all the *Leucanias* feed chiefly on grasses, as far as is known.

1975 *L. inermis* Forbes. Plate VII, Figure 7.

Digby, Annapolis, South Milford, Round Hill, Annapolis County. June 4 - 23, at light. Scarce, though not as local as *pesudargyria*, and seemingly confined to the same general area in southwestern Nova Scotia.

1977 *L. commoides* Gn.

Digby, Annapolis, Petite Riviere north to Lakelands, Cumberland County and Great Village. June 30 - August 15, at light. Sometimes plentiful, especially in Digby and Annapolis counties.

1979 *L. scirpicola* Gn. Plate VII, Figure 10.

Probably this species. Lequille, June 16, 1949; South Milford, June 27, 1951; Great Village, July 18, 1948. Rare.

1982 *L. multilinea* Wlk.

Digby, Annapolis, Centreville, Mount Uniacke, Armdale and Baddeck. July 9 - August 10. Widely distributed, but never common.

1992 *L. insueta* Gn.

Digby, Annapolis, Petite Riviere north to Springhill and Baddeck. June 30 - August 22. Common.

1994 *L. unipuncta* Haw. Armyworm.

Generally distributed, and always present at baited trees, often in enormous numbers. April 10 - November 27.

1995 *L. luteopallens* Sm.

Seems to occur everywhere, often in abundance at both light and bait. July 5 - September 11.

Cuculliinae

Cucullia Schrank

2038 *C. intermedia* Speyer

White Point Beach, Digby to Stellarton and Baddeck. Not uncommon. May 28 - July 27, at light. Larva on various Compositae.

2041 *C. florea* Gn. Plate VIII, Figure 9.

Lequille, Annapolis, Round Hill, Armdale, MacNab's Island, Enfield. June 13 - August 25. Least common of the recorded *Cucullias*. Bred from green larvae, with thin white and yellowish lines, on *Aster umbellatus* and *Solidago graminifolia*.

2042 *C. postera* Gn. Plate VIII, Figure 10.

White Point Beach, Lequille, north to Three Brooks, Pictou County, Truro and Cole Harbour. June 29 - September 28, at light. Commoner than *florea*, but larva not known.

2046 *C. convexipennis* G. & R.

White Point Beach, Digby, Annapolis to Stellarton and Baddeck. July 6 - August 25, at light. Also taken at dusk along with Sphingidae at honeysuckle and *Oenothera* flowers. Moderately common. The vividly colored larva often found on *Solidago*.

Oncocnemis Led.

2116 *O. piffardi* Wlk. Plate VII, Figure 9.

Digby, August 28, 1937; Halifax (Andrew Downs); Truro, August 20, 1922 (Payne); Debert, September 12, 1952 (Harrington). Rare.

Homohadena Grt.

2147 *H. badistriga* Grt.

Economy, Colchester Co., July 16, 1946 (A.D. Hall). Determined by Dr. McDunnough.

Adita Grt.

2155 *A. chionanthi* A. & S. Plate VIII, Figure 8.

Digby, September 19, 1907 (Russell). One rather worn specimen.

Apharetra Grt.

2156 *A. dentata* Grt. Plate VII, Figure 5.

Digby, White Point Beach, Mount Uniacke, Halifax, Halifax watershed area, Shad Bay, Three Brooks, Glenville. July 12 - August 26. Sometimes quite common at light in the localities near Halifax, especially on the bogs. Larvae on *Vaccinium* (McDunnough). One bred from a larva eating blueberry, Prospect Road bog.

Feralia Grt.

2183 *F. jocosa* Gn.

MacNab's Island, June 8-14; Halifax watershed area, May 9, 1951; Mount Uniacke, May 25, 1950., May 5, 1953. The MacNab's Island specimens include an example of form *jocosides* Strand, and an example of an unusual, deep brown form without any green coloring. Larva on spruce, hemlock and probably other conifers. It has been reared through to the adult by the Canadian Forest Insect Survey on red and black spruce.

2185 *F. major* Sm. Plate VIII, Figure 11.

Digby, 1933 (Russell). French Mountain, Inverness County, 1390 feet, June 16, 17, 1953, 2 specimens. Rare.

2186 *F. comstocki* Grt. Plate VIII, Figure 12.

Lake Kejimukujik, Waverley, Mount Uniacke, MacNab's Island, Armdale, Stellarton French Mountain. May 20 - June 18, at light. Not common, but in recent years has occurred much more frequently than *jocosa*. The specimen figured is one from Mount Uniacke, in which most of the green is suffused with brown. White-striped green larvae found repeatedly on balsam fir are probably referable to this species, although none were reared through. In western New York localities where spruce and fir do not grow, the host plant appears to be hemlock.

Psaphida Wlk.

2191 *P. grotei* Morr.

Round Hill, Annapolis County, May 10, 1937, at light (F. C. Gilliatt). Larva probably on oak.

Bombycia Steph.

2207 *B. algens* Grt. Plate X, Figure 1.

Aylesford, Kings County, August 26 - September 11, 1951-52. Abundant at light in the same marsh habitat occupied by such species as *Archanara oblonga*, *Hillia iris* and *Macronoctua onusta*. Very local, and seemed concentrated right in the wettest parts of the marsh where the cat-tails grow. A few came to bait. Also at Cole Harbour, a single specimen on August 29, 1951 (Harrington).

Hillia Grt.

2211 *H. iris* Zett. Plate VII, Figures 12 & 13.

Aylesford, September 10, 1952, October 3, 1950; Centreville, October 2, 1950 (three), at light and bait. The form *vigilans* Grt. at Great Village, 1945 (Hall), and Aylesford, September 10, 11, 1952 (six), October 3, 1950 (two). Seems associated with marshy places.

Lithomia Grt.

2215 *L. napaea* Morr.

Bridgetown, Greenwood, Armdale, MacNab's Island, Stellarton. March 16-May 27, and September 29 - October 17. Hibernates as an adult. Often common at bait.

Lithomoia Hbn.

2216a *L. solidaginis germana* Morr.

Digby, through the Annapolis Valley and Mount Uniacke to Halifax, and Wellington Station, Halifax County, Parrsboro and Stellarton. Aug. 19 - October 28, at bait and *Solidago* flowers. Commonest in or near open areas where *Solidago*, the probable host plant, grows abundantly.

Lithophane Hbn. (*Graptolitha* Hbn.)

2220 *L. bethunei* G. & R.

Abundant in the Annapolis Valley; present, though scarcer, at MacNab's Island, Cole Harbour, Armdale, Wellington, Stellarton. September 2 - November 3, and April 8 - June 3. Hibernates as an adult, like all the *Lithophanes*. Bred at Annapolis, August 30, from a larva on oak, and at Kentville, September 5, from apple. Probably the most injurious of the green fruit worms in the Annapolis Valley.

2221 *L. innominata* Sm.

Possibly all as normal form *illecebra* Franclemont. Digby, Mount Uniacke, Wellington, Stellarton and the vicinity of Halifax. Common, September 4 - November 2, April 8 - May 17, at bait.

2222 *L. petulca* Grt.

Digby, Bridgetown, Armdale, MacNab's Island, Purcell's Cove, Stellarton. September 13 - November 3, April 8 - 28. Dark brown suffused form, *ferrealis* Grt. (2223), slightly scarcer than true *petulca.* Probably a rather general feeder on deciduous trees.

2224 *L. amanda* Sm.

Stellarton, no date (Hills coll.). The only specimen seen.

2225 *L. disposita* Morr.

Bridgetown, Aylesford, Centreville, Armdale, MacNab's Island, Stellarton. September 10 - October 3, and April 3. Common at bait in willow-alder swampland at Aylesford. Probably a willow feeder.

2226 *L. hemina* form *lignicosta* Franclemont

Bridgetown, September 29; Wolfville, May 8, 1949; Halifax watershed area, September 29, 1952; Wellington, October 12, 1950; Stellarton, no date. *Lignicosta* is the brown suffused form of *hemina* Grt. corresponding to form *ferrealis* of *petulca*, but there is considerable doubt about the determination of these specimens, partly because the unsuffused *hemina* has never turned up here. I strongly suspect that some of them, perhaps all, are actually referable to the true *innominata* Sm., which bears the same relationship to *illecebra* as *ferrealis* does to *petulca.*

2234 *L. baileyi* Grt. Plate IX, Figure 1.

Digby, September 17, 1906, September 28, 1907; Wellington, Halifax County, October 9, 1950. Rare.

2241 *L. tepida* Grt. Plate IX, Figure 2.

Digby, Bridgetown, Caledonia, Mount Uniacke, Armdale, Peggy's Cove, MacNab's Island, Cole Harbour. September 16 - October 20, April 10-May 19. Not uncommon at bait some seasons.

2244 *L. georgii* Grt. Plate IX, Figure 3.

Digby, Round Hill through the Annapolis Valley and Mount Uniacke to Halifax, and northward at Stellarton. September 10 - October 25, April 13. Not usually common. Probably a rather general feeder as it was bred from apple at the Dominion Entomological Laboratory, Kentville.

2245 *L. laticinerea* Grt.

Digby, Bridgetown, Greenwood, Wellington, Armdale, Peggy's Cove. September 1 - October 25, March 29 - April 18. Rather common. Probably general on deciduous trees.

2246 *L. cinerosa* Grt.

Digby, Bridgetown, Centreville, Armdale. August 23 - October 20, April 10 - 22. Much scarcer than *laticinerea*. Larvae reported from birch and maple by the Canadian Forest Insect Survey.

2247 *L. unimoda* Lint.

Bridgetown, Armdale, Halifax watershed area, Stellarton. October 8-25, April 8 - May 25. Scarce. Reported on cherry, oak and maple.

2248 *L. fagina* Morr.

Digby, Round Hill to Armdale and MacNab's Island, and northward at Stellarton. September 29 - October 25, March 26 - May 28. Always one of the commonest *Lithophanes*. Larva on birch and cherry (Canadian Forest Insect Survey).

2252 *L. pexata* Grt.

Digby, Centreville, vicinity of Halifax, Stellarton, Baddeck. September 5 - October 8, April 8 - May 3. Not uncommon. Larva reported on alder.

2255 *L. lepida* Lint. Plate IX, Figure 4.

Armdale, April 10 and 13, 1945, at bait. Rare.

2258 *L. thaxteri* Grt.

Annapolis, Caledonia, Waverley, Armdale, MacNab's Island, Peggy's Cove, Glenholme. September 22, April 13 - June 12 at light' and bait. Scarce. Larva has been reported on larch.

Xylina Ochs.

2259 *X. nupera* Lint.

Greenwood, Centreville, Halifax, Parrsboro, Stellarton, Baddeck September 10 - October 18, March 26 - May 21, at bait. Bred from large, green larvae on marsh grasses and *Juncus*.

2260 *X. curvimacula* Morr.

Aylesford, Wellington, Armdale, MacNab's Island, Stellarton. September 24 - November 26, April 2 - May 21. This is always the commonest species of *Xylina*.

2262 *X. thoracica* Put.-Cram. Plate IX, Figure 5.

Centreville, October 2, 1950; Armdale, October 1, 1950; MacNabs Island, April 15, 1923; Debert, May 20, 1952; Stellarton no date. The scarcest of the four species. On various plants, but shows a preference for willow (Dod, Can. Ent., Vol. 47, p. 126).

2263 X. *cineritia* Grt. Plate IX, Figure 6.

Greenwood, Armdale, Halifax watershed area, Stellarton. April 10 - May 6, at bait. Quite common some seasons in deciduous woods near Armdale. Feeding habits reported to be similar to *thoracica.*

Xylotype Hamp.

2266 X. *acadia* B. & B. Plate IX, Figure 7.

Barnes and Benjamin, Contributions Nat. Hist. Lep. N. A., Vol. V (1), p. 33, 1922. Type locality: Digby

Digby, Centreville, Aylesford, Mount Uniacke bog, Wellington, Armdale, Prospect Road, MacNab's Island, Cole Harbour, Great Village. August 29 - October 12, at light and bait. Not especially common. The date on the allotype, August 3, 1906, is exceptionally early, and might be an error of labelling. Early September is the normal time for the species to appear.

Platypolia Grt.

2268 *P.* *anceps* Steph.

Digby, vicinity of Halifax, Baddeck (Engelhardt). September 10 - October 18, at light, once at bait. Not very common. Bred from *Aster macrophylla* (Dr. Brower).

Mniotype Franclemont

2272 *M.* *ducta* Grt. Plate IX, Figure 8.

Digby, MacNab's Island, Peggy's Cove, Stellarton. June 20 - July 20. Generally rare, although it was taken in series at Digby by Mr. Russell. There is some doubt about the determination of our material, and it needs more careful study.

A single female from Cole Harbour, Halifax County, July 31, 1950 (W. Harrington), is much darker than the others, and seems to differ in other minor ways. It is possibly another species.

Fishia Grt.

2283 *F.* *enthea* Grt. Plate IX, Figure 9.

This is another species that has not been determined with certainty, since so little material is available for study. Debert, September 24, 1952, at light; Great Village, September 7, 1945; Stellarton, no date. Very rare.

Anytus Grt.

2285 *A.* *privata* Wlk.

Digby, Smith's Cove, Lake Rossignol to Parrsboro and Stellarton. Probably general. August 11 - October 1, at light and bait. Common. Varies greatly in the proportions of gray and black scaling on the primaries.

Chaetaglaea Franclemont

2289 *C. sericea* Morr.

Aylesford, Centreville, Wellington, Armdale. September 11 - November 3. Abundant at bait in the Annapolis Valley localities; scarcer elsewhere.

Epiglaea Grt.

2294 *E. apiata* Grt.

Aylesford, Centerville, Armdale, Prospect Road bog, Peggy's Cove, Debert. September 11 - October 4. The first evidence of its occurrence here was a specimen beaten from low vegetation in the daytime on a small, isolated bog at Armdale, September 1950, in a small tract of pine woods known locally as Edmonds' Grounds. Subsequently, it was found to be numerous in suitable boggy areas, and came to both light and bait. At Centreville, a few even came to light in dry woodland. Larva supposedly a cranberry feeder.

Metaxaglaea Franclemont

2296 *M. inulta* Grt.

Bridgetown, Auburn, Aylesford, Centreville, Lake Rossignol, Debert, Stellarton, Wellington, and in great abundance in the woods about Halifax. August 24 - November 3, mostly at bait. Commonest of the "*Glaeas*". Also occurs as a dark smoky-suffused form evidently tending towards melanism.

Pyreferra Franclemont

(2299) *P. hesperidago* Gn. (*indirecta* Wlk.)

Armdale, October 15 - November 3, April 8 - 15; Wolfville, May 8, 1949. Hibernates as an adult. Not common. Larva has been reported on *Hamamelis*.

(2300) *P. citrombra* Franclemont (*graefiana* Grt.)

Armdale, Halifax watershed area, Wellington, Wolfville, Caledonia. October 7-November 3, April 2 - May 16, at bait. Scarce.

Eupsilia Hbn.

2303 *E. tristigmata* Grt.

Bridgetown, Kentville, Wellington, Armdale, MacNab's Island, Stellarton. October 12 - November 3, March 22 - May 21. Not uncommon at bait, especially in the spring. Reared from a "dark brown, velvety fruitworm" at the Dominion Entomological Laboratory, Kentville.

2304,1 *E. vinulenta* Grt.

Digby, Bridgetown, Armdale, Wellington. October 12 - November 3, March 26 - May 3, at bait. Rather scarce.

2305 *E. morrisoni* Grt.

Armdale, Halifax watershed area, Wellington, Halifax County, October 12 - November 3, April 12 - May 8, at bait. Often abundant, especially in the spring. Commonest of the *Eupsilias* in the woods near Halifax. Probably rather a general feeder on deciduous trees.

2306 *E. devia* Grt.

Annapolis, Bridgetown, Wellington, Hubbards, Parrsboro, Stellarton and the vicinity of Halifax. September 25 - October 12, March 17 - April 22. Occasionally common at bait. Bred September 4, 1950 from larvae tying up the terminal leaves of *Aster umbellatus* in June, and similar larvae also observed that season on a species of *Solidago*.

Parastichtis Hbn.

2309 *P. discivaria* Wlk.

Digby, Lawrencetown, Bridgetown, Centreville, Armdale. July 15 - September 4, at bait. Not common.

Rusina Steph.

2312 *R. bicolorago* Gn.

Digby, Aylesford, Centreville, Bridgetown, Wellington, Stellarton, and the vicinity of Halifax. September 11 - November 21. Form *ferrugineoides* Gn. in swarms at bait in late fall, typical form *bicolorago* much scarcer.

Xanthia Ochs.

2316 X. *lutea* Strom.

Bridgetown, Aylesford, Centreville, Wellington, Armdale, MacNab's Island, Debert, Stellarton. September 3 - October 9. Sometimes abundant at bait in the Annapolis Valley localities, rare in Halifax County.

Anathix Franclemont

2318 *A. puta* G. & R. Plate VII, Figure 8.

Aylesford and Armdale. September 3 - October 4, at light and, more often, bait. Scarce.

Eucirrhoedia Grt.

2321 *E. pampina* Gn.

Aylesford, Coldbrook, Centreville, Wellington, Debert, Stellarton, and in the woods about Halifax. Very common and probably present everywhere. August 31 - November 2, at light and bait. Larva on poplar.

Homoglaea Morr.

2324 *H. hircina* Morr.

Greenwood, Kings County, March 29, April 19, 1945; deciduous woods, Halifax watershed area, April 13 - May 3, at bait. Normally uncommon. Larva on poplar.

Amphipyrinae

Septis Hbn.

2328 *S. verbascoides* Gn.

Digby, Centreville, Three Brooks, and various localities in Halifax County. July 4 - August 4 at bait and, less commonly, at light.

2334 *S. vulgaris* G. & R.

Acaciaville, Digby County, July 26, 1949. A single worn female at light.

2335 *S. lignicolora* Grt.

Generally distributed and often moderately common at light. June 22 - August 10.

2344 *S. vultuosa* Grt.

Digby, Lequille, Bridgetown, Armdale, MacNab's Island, Three Brooks, Baddeck, French Mountain. June 13 - August 1, at light. Not common.

2346 *S. apamiformis* Gn. Plate IX, Figure 10.

Centreville, Kings County, July 22, 1949. Two females at bait.

2347 *S. plutonia* Grt. Plate IX, Figure 12.

Valley of the Cheticamp River, Inverness County, July 2, 1949. One male at light.

2351 *S. amputatrix* Fitch

Generally distributed and often abundant at light and bait. July 8 - September 6. This is the species formerly known as *S. arctica* Frr., but this name is a homonym of *arctica* Zett.

2353 *S. alia* Gn.

Round Hill, Halifax, Cole Harbour, Great Village. July 7 - 31, at light. Not common. Includes form *rorulenta* Sm.

2355 *S. inordinata* Morr.

Isle Haute, Bay of Fundy, Greenwood, Kings County, Armdale, MacNab's Island. June 5 - July 1, at light. Scarce.

2361 *S. commoda* Wlk.

Truro, August 20, 1923. A single worn male (in the Canadian National Collection).

2362 *S. impulsa* Gn.

Digby, White Point Beach, Petite Riviere, Waverley, MacNab's Island, Armdale, Debert, Stellarton. June 22 - August 25, at light.

2363 *S. mixta* Grt. Plate IX, Figure 11.

Centreville, Kings County, July 22, 1949; Armdale, September 7, 1948; Parrsboro, August 15, 1944. Rare.

2364 *S. indocilis* Wlk.

Digby, Waverley, Armdale, MacNab's Island, Mason's Point, Halifax County. July 2 - August 11, at light. Not usually common.

2365 *S. finitima* Gn.

Digby, South Milford, Centreville, Isle Haute, Truro, Armdale, MacNab's Island, Port Wallis. June 3 - August 6, at light. Not uncommon about Halifax.

Agroperina Hamp.

2366 *A. lateritia* Hufn.

Annapolis, Auburn, Kentville, Petite Riviere, St. Margaret's Bay, MacNab's Island, Stellarton. June 29 - July 20. Local and not especially common.

2368 *A. dubitans* Wlk.

Abundant everywhere, mostly at bait, July 16 - October 1.

2638a *A. cogitata* Sm.

Previously placed as just a reddish form or variety of *dubitans*, *cogitata* is now considered a distinct species. Widely distributed from Digby to Baddeck, but it is scarcer than *dubitans* and more local. June 25 - August 4, usually at light. Like *lateritia*, this species occurs most commonly in open country rather than woods.

2370 *A. inficita* Wlk.

Armdale, August 15, 1950, one male at light; St. Peter's, Richmond County, August 14, 1930 (R. E. Balch); top of North Mountain. Inverness County, August 3, 1953.

Crymodes Gn.

2375 *C. devastator* Brace

Abundant everywhere at bait. June 20 - September 6.

Protagrotis Hamp.

2383 *P. niveivenosa* Grt.

Great Village, Colchester County, no date (A. D. Hall).

Luperina Bdv.

2387 *L. stipata* Morr.

Annapolis, Round Hill, Bridgetown, Coldbrook, Grand Pré, White Point Beach, Armdale, MacNab's Island. August 11 - September 20. Inhabits open country chiefly, including salt marshes and dykelands.

2393 *L. passer* Gn.

Digby, Round Hill, Bridgetown, Lawrencetown, Centreville, Baddeck. June 15 - July 23, at light. Scarcer than *stipata*, and probably also limited to open, grassy country.

Oligia Hbn.

2412 *O. modica* Gn.

White Point Beach and Bridgetown to Great Village, Stellarton and Baddeck. Seemingly quite general. July 21 - September 10, at light and bait. Sometimes common.

2415 *O. semicana* Wlk. Plate VII, Figure 15.

Peggy's Cove, July 8, 1951, seven specimens at light; Prospect Road area, Halifax County, August 10, 1950; Mount Uniacke, July 10, 1951, August 11, 1950; Great Village, no date. Scarce.

2417 *Oligia* sp, possibly a race of *tonsa* Grt. Plate VII, Figure 14.

Very dark. Lacks the black bar between the t.p. and t.a. lines. Near Partridge Island, Parrsboro, July 30, 1948, at light. One specimen only.

2420 *O. bridghami* G. & R.

Widely distributed from White Point Beach and Digby north to Parrsboro and Three Brooks, Pictou County, but uncommon most places. July 20 - September 19, at light and bait.

2421 *O. minuscula* Morr. Plate VII, Figure 11, form *grahami.*

Digby, Round Hill, Lake Rossignol, Auburn, Mount Uniacke, Peggy's Cove, Herring Cove and the Prospect Road, Halifax County, August 11 - September 22, at light. Rarely strays far from its bog haunts.

Grahami Benj. (Pan Pac. Ent., Vol. IX, p. 150. Type locality: Cap Rouge, Inverness County. Types a male and a female taken by Graham Fairchild, September 2, 1928) is at best probably only a form, since only a few individuals from scattered localities fit Benjamin's description.

2422 *O. diversicolor* Morr.

Annapolis, Round Hill, Bridgetown, Auburn, Aylesford, Armdale, Peggy's Cove, Great Village, Stellarton. August 24 - September 29, at light. Common in a cat-tail marsh at Aylesford.

2423 *O. illocata* Wlk.

Bridgetown, Aylesford, Mount Uniacke, Armdale, MacNab's Island, Cole Harbour, Peggy's Cove, Stellarton. August 26 - November 3. One of the commonest moths at bait in the fall.

2424 *O. mactata* Gn.

Digby, Bridgetown, Armdale, MacNab's Island, Great Village. August 24 - September 27, at bait. Occurs commonly along with *illocata.*

Eremobina McD.

2430 *E. claudens* Wlk. Plate VII, Figure 16.

It seems reasonable to believe that the species occurring in Nova Scotia is *claudens* Wlk., described from Newfoundland, although it is really doubtful whether there is any specific difference between *claudens* and *hilli* Grt. Average Nova Scotian specimens agree better with Hampson's figure of *claudens* than with his figure of *hilli* (Lep. Phal. Br. Mus., Vol. VII, pl. CXVIII, figs. 19 and 21).

Digby, Annapolis, Bridgetown, Mount Uniacke, MacNab's Island, Armdale, Debert, Great Village, Baddeck and St. Peter's, Richmond County. August 14 - September 20, at light and bait. Quite rare.

Spartiniphaga McD.

2436 *S. inops* Grt. Plate VII, Figure 18.

Annapolis, Lequille, Round Hill, Lawrencetown, Great Village. August 24 - September 3, at light. Seems to be associated with the marshy grassland bordering the lower, tidal Annapolis River. Might be a salt marsh species.

2437 *S. includens* Wlk.

Walker, Lep. Het. Brit. Mus., pt. XII, p. 813, 1857. Type locality: Nova Scotia.

Armdale, July 18 - August 15; Mount Uniacke bog, August 11; Great Village, no date. Very local. The larva feeds on *Carex stricta*, according to Dr. A. E. Brower.

2438 *S. panatela* Sm. Plate VII, Figure 17.

Annapolis, Lequille, South Milford, Mount Uniacke, Halifax watershed area. June 17 - July 26, at light. Locally common near the coarse grasses that grow in marshy spots in the woods, or along streams.

Archanara Wlk.

2439 *A. oblonga* Grt.

White Point Beach, Annapolis, Round Hill, Aylesford, Grand Pré, Great Village, Debert, Parrsboro, Stellarton. August 16 - September 20. Often common at light in marshy areas, where the larvae bore in the stems of cat-tails.

2440 *A. subflava* Grt. Plate X, Figure 2.

White Point Beach, Peggy's Cove, Wolfville, Great Village, Debert. August 8 - September 5. Usually rare, though a number were taken at Great Village. Reported by Dr. Frank Morton Jones as feeding on Great Bulrush (presumably *Scirpus validus* Vahl.) on Martha's Vineyard.

Ommatostola Grt.

2445 *O. lintneri* Grt.

Barrington Passage, White Point Beach, Crescent Beach (Petite Riviere), Sable Island (August 16, 1899), July 28 - August 26, mostly at light. A single worn specimen flying by day over the coarse grass of the sand dunes on Crescent Beach.

Hypocoena Hamp.

2448 *H. inquinata* Gn. Plate VII, Figure 20.

Acaciaville, West Northfield, Lunenburg County, Herring Cove, Armdale, Halifax watershed area. July 20 - August 17. Locally common in much the same situations as *Spartiniphaga panatela*.

2449 *H. orphnina* Dyar. Plate VII, Figure 19.

Annapolis, Lequille, Round Hill, Grand Pré, Peggy's Cove, Debert, Great Village. July 25 - September 16, at light. These localities suggest an association with the salt marshes surrounding the Bay of Fundy and extending inland along its tidal rivers. *Orphnina* was quite common at street lamps in Annapolis Royal, a town almost surrounded by open marshes, and at Grand Pré I took it at lights set up along the edge of a salt marsh.

Zenobia Oken

2453 *Z. pleonectusa* Grt.

Digby, Auburn, Aylesford, Centreville, Wellington, vicinity of Halifax, Cole Harbour, Stellarton. July 26 - October 12, at light. Larva on poplar.

Helotropha Led.

2457 *H. reniformis* Grt.

White Point Beach and Acaciaville to Glenville, Cumberland County and Three Brooks, Pictou County. Probably general. July 18 - October 4. Often plentiful at bait, most commonly as form *atra* Grt.

Apamea Ochs.

2458 *A. velata* Wlk.

Numerous records from Digby and White Point Beach to Stellarton and Baddeck. July 15 - August 24, at light. Common.

2459 *A. americana* Speyer

Digby, White Point Beach north to Pictou and Baddeck. Presumably general. July 16 - October 6, at light and bait. Abundant. Larvae supposed to feed in the roots of grasses.

Hydroecia Gn.

2474 *H. micacea* Esp.

Mahone Bay and Cole Harbour to Stellarton, Truro and Parrsboro, and from Annapolis to Hortonville in the Annapolis Valley. Probably much more widely distributed. July 31 - September 29, at light. Common some seasons.

Papaipema Sm.

2479 *P. appassionata* Harv. Plate XI, Figure 1.

Peggy's Cove, September 18 - 22, 1952. Ten specimens at light. The larvae bore in the stems and roots of pitcher plant (*Sarracenia*).

2481 *P. inquaesita* G. & R. Plate XI, Figure 4.

Round Hill, Aylesford, Centreville, Wellington, Armdale, Great Village. September 6 - October 12, at light. Locally common. Form *wyatti* B. & B., with white-filled reniform and orbicular, once only, at Aylesford. The larva is a fern-feeder, reported on *Onoclea*.

2501 *P. harrisi* Grt.

Larvae of a *Papaipema*, assumed to be this species, were found feeding inside the pithy stems of *Heracleum lanatum*, together with the much more numerous larvae of a Micro — *Depressaria heracleana* Linn., on North and French Mountains, Inverness County, August 1 - 5, 1953. Four adults emerged September 1 - 4.

2505 *P. impecuniosa* Grt.

Round Hill, Aylesford, Debert, Great Village. September 16 - October 13, at light. Very common at Great Village, otherwise just taken occasionally. Larva bores in *Aster umbellatus.*

2509 *P. pterisii* Bird

Round Hill, Aylesford, Coldbrook, Centreville, Wellington, Peggy's Cove, Cole Harbour, vicinity of Halifax, Debert, Great Village, Stellarton. August 31 - October 17, at light. Commonest of the *Papaipemas.* The larva bores in the roots of the common bracken fern, *Pteridium aquilinum.*

2521 *P. frigida* form *thalictri* Lyman. Plate XI, Figure 6, *frigida.*

Round Hill, Aylesford, Armdale, Cole Harbour, Stellarton. September 10 - November 2, at light. Typical form *frigida* Sm. only once, Aylesford, October 3, 1950. The larva feeds in the roots of meadow rue (*Thalictrum*).

2530 *P. eupatorii* Lyman. Plate XI, Figure 3.

Aylesford, Kings County, October 3, 1950. One male at light. Host plant Joe-Pye weed (*Eupatorium*).

Euplexia Steph.

2533 *E. benesimilis* McD.

Digby, Lequille, St. Margaret's Bay to Stellarton and Baddeck. Presumably general. June 5 - July 26, at light. Common. Reported (as *lucipara* Linn.) on *Viburnum*, *Betula*, etc. by Henry Edwards, but this may refer to the European species.

Phlogophora Tr.

2535 *P. iris* Gn.

Annapolis, Stellarton, Three Brooks, Baddeck, Cheticamp, vicinity of Halifax. June 9 - July 20, at light. Usually quite common.

2536 *P. periculosa* Gn.

Generally distributed. July 19 - October 1. Always comes abundantly to bait, *periculosa* and form *v-brunneum* Grt. in about equal numbers. Bred at Halifax from larvae on *Acer rubrum* and *Kalmia angustifolia.* The *Kalmia* is apparently a regular food plant, as a number of small larvae found on it in the spring were reared to maturity.

Haploolophus Butl.

2539 *H. mollissima* Gn.

Annapolis Valley, vicinity of Halifax, and at White Point Beach. Bridgewater, Petite Riviere and Baddeck. June 23 - July 25, at light Not uncommon. Larva probably a fern-feeder.

Euherrichia Grt.

2540 *E. monetifera* Gr.

White Point Beach to Glenville, Cumberland County, Three Brooks, Pictou County and Baddeck. Seems to occur everywhere. June 16 - August 16. Larva on bracken fern.

Fagitana Wlk.

2543 *F. littera* Gn. Plate VII, Figure 21.

Lake Kejimukujik, Queens County, May 29, 1950. One female at light in beech-hemlock woods.

Macronoctua Grt.

2546 *M. onusta* Grt.

Round Hill, Aylesford, Armdale, MacNab's Island, Great Village. September 13 - October 8, at light. Occurs sparingly and locally near marshy areas. Larva on *Iris.*

Chytonix Grt.

2554 *C. palliatricula* Gn.

Form *iaspis* Gn., without the conspicuously white median space, most commonly. Lequille, South Milford, Auburn, Armdale, MacNab's Island, Port Wallis, Pictou, Cheticamp. June 5 - July 31. Often common at both light and bait in mixed forest.

Typical form, *palliatricula*, at Armdale and Rockingham, Halifax County, June 13 - July 22.

Cerma Hbn.

2559 *C. cora* Hbn. Plate XI, Figure 7.

Acaciaville, Annapolis Royal, Lequille, Round Hill, Mount Uniacke. June 15 - July 10, at light. Rare.

Leuconycta Hamp.

2576 *L. diphteroides* Gn.

Annapolis Valley from Digby to Centreville, White Point Beach, vicinity of Halifax, Debert, Baddeck. June 12 - August 11, including form *obliterata* Grt. Common.

2577 *L. lepidula* Grt.

White Point Beach and Annapolis to Three Brooks, Pictou County and Baddeck. June 13 - August 4, at light. Usually commoner than *diphteroides*.

Agriopodes Hamp.

2578 *A. fallax* H.-S.

Occurs from Barrington Passage to Baddeck. June 20 - August 20, at light and bait. Often quite common in deciduous woods. The larva has been reported on poplar and *Viburnum*.

Amphipyra Ochs.

2584 *A. pyramidoides* Gn.

Digby, August 4, 1905; Lake Rossignol, August 21, 23, 1951, at bait. Scarce. A general feeder on deciduous trees.

2585 *A. tragopoginis* L.

Annapolis Valley from Digby to Wolfville, Mount Uniacke, vicinity of Halifax, Truro, Parrsboro, Stellarton, Pictou, Baddeck. July 20 - September 3, at bait. Common. Probably also a general feeder.

Dipterygia Steph.

2587 *D. scabriuscula* L.

Annapolis Royal, Waverley, Mason's Point, Halifax County, Great Village. July 7 - August 10, at light and bait. More taken at Annapolis than elsewhere.

Nedra Oken

2589 *N. ramosula* Gn.

White Point Beach and Annapolis to Parrsboro, Three Brooks and Baddeck. Probably occurs wherever the food plant, St. John's wort (*Hypericum*) grows. Two broods: May 27-June 30 and July 23 - August 22. Often plentiful at light.

Andropolia Grt.

2596 *A. contacta* Wlk. Plate X, Figure 3.

Glenville, Cumberland County, August 9 and 10, 1949. Five specimens at bait in deciduous woods.

Hyppa Dup.

2607 *H. xylinoides* Gn.

Generally distributed, Barrington Passage to Baddeck. Two broods, overlapping: May 19 - September 20. Often abundant at bait. A very general feeder.

According to Mr. Franclemont, two species are involved, both of them occurring in Nova Scotia. One of these (*ancocisconensis* Morr.?) has narrower antennae in the male, very different female genitalia and is single brooded. The double brooded species with wide antennae is *xylinoides* Gn.

Elaphria Hbn.

2645 *E. versicolor* Grt.

White Point Beach and Digby to Three Brooks and Baddeck. June 4 - July 10, with one very late record for August 19. Often plentiful at light. Larva mottled black and brown with swollen thoracic region, on spruce and fir.

——— *E. georgei* Moore & Rawson. Plate XI, Figure 5.

Lequille, Annapolis Co., June 13 - 22, 1949 and 1950, seven specimens at light in mixed woods; South Milford, June 27, 1951; Mount Uniacke, June 1 and 22, 1951, five specimens at light; Waverley, June 1, 1952; Prospect Road bog, July 3, 1951. Scarce and local. Seen only from Michigan, Quebec and Nova Scotia. *Georgei* was described recently from Livingstone Co., Michigan.

2647 *E. festivoides* Gn.

White Point Beach, Lake Kejimukujik and Digby to MacNab's Island, Armdale, Mount Uniacke and Centreville. Probably everywhere. May 31 - July 18, and once as late as August 15. Often plentiful at light and bait.

Mr. Franclemont informs me that two or more species have been masquerading under this name, and just which name, if any, is available for the small gayly colored one occurring here has not yet been established.

Platyperigea Sm.

2655 *P. multifera* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. X, p. 293, 1856.
Type locality: Nova Scotia.

Annapolis, Bridgetown, Lake Rossignol, Auburn, Armdale, MacNab's Island, Great Village, Stellarton. August 15 - September 12, at light.

Proxenus H.-S.

2662 *P. miranda* Grt.

Round Hill, Mount Uniacke bogs, Prospect Road bog, Peggy's Cove, Glenville, Baddeck. June 15 - July 29. Local, but often very common at light where it occurs.

Galgula Gn.

2666 *G. partita* Gn.

Round Hill, Petite Riviere and Armdale. July 2, 16, August 2, and August 17 - October 22, at light. Scarce.

Balsa Wlk.

2669 *B. malana* Fitch

Digby, Annapolis, Bridgetown, Auburn, Coldbrook, Londonderry, Colchester County, Glenville, Cumberland County, Baddeck. June 5 - July 18, and once on August 22. Never taken in Halifax County, and seems to avoid the whole south-eastern area. Larva on apple.

Prodenia Gn.

2678 *P. ornithogalli* Gn.

Armdale, August 2 - September 6, mostly at bait. Not common.

Laphygma Gn.

2682 *L. frugiperda* A. & S.

Bridgetown, Wellington, Armdale, Lakelands, Cumberland County. June 30, and July 30 - October 15 at light and bait. Common some seasons.

Enargia Hbn.

2685 *E. decolor* Wlk.

Centreveille, Kings County, Oct. 2, 1950, at bait (one male, one female); Glenville, Cumberland County, August 11, 1949, at bait. Much scarcer and more local than the following.

2685, 1 *E. infumata* Grt. Plate X, Figure 4.

Digby, Lawrencetown, Mount Uniacke, Armdale, Parrsboro, Glenville. July 15 - September 10. Often abundant at bait. Larva probably on poplar.

Cosmia Ochs.

2687 *C. calami* Harv.

Lequille, Round Hill, Lake Rossignol, Cole Harbour, Port Wallis. July 24 - August 29, at light. A specimen from Chester Basin, Lunenburg County bred from red oak (Canadian Forest Insect Survey).

Amolita Grt.

2694 *A. fessa* Grt.

Annapolis, Round Hill, Centreville and at Green Bay, Lunenburg County. July 16 - 30, at light. Scarce and seems restricted to the Southern region.

Arzama Wlk.

2703 *A. obliqua* Wlk.

Annapolis, South Milford, Centreville, Great Village, Stellarton, Baddeck. June 4 - July 6, at light. Locally common in and near marshes, where the larvae feed in the stems of cat-tail (*Typha*).

Achatodes Gn.

2711 *A. zeae* Harr.

Armdale, August 15 - 25, at light, and once on the Mount Uniacke bog, August 10. It was rather common at Armdale in 1948, but has not reappeared since. The larvae feed on the pith inside the stems of *Sambucus*, and farther south sometimes attack the stems of cultivated corn.

Pyrrhia Hbn.

2715a *P. umbra exprimens* Wlk.

Armdale, MacNab's Island, Baddeck. June 28 - August 19, at light. Local and usually scarce. Larva white, finely flecked and streaked with black, lateral stripe orange and segmental patches of orange on the dorsum; on sweet fern at Annapolis.

Ogdoconta Butl.

2773 *O. cinereola* Gn.

Grand Pré, August 28, 1952. Two rather worn specimens at light in open grassy country at the edge of a salt marsh.

Eutricopis Morr.

2871 *E. nexilis* Morr. Plate XI, Figure 8.

Sackville, Halifax County, May 20, 1951. One specimen taken hovering over blossoms of *Houstonia caerulea* and two others seen. Coldbrook, Kings County, May 24, 1952, visiting flowers of the larval food plant, *Antennaria*

Heliothiinae

Heliothis Ochs.

2932 *H. obsoleta* Fabr. Corn-ear worm.

White Point Beach, Round Hill, Aylesford, Armdale, Peggy's Cove, Mount Uniacke, Cole Harbour, Port Wallis, and James River, Antigonish County. August 9 - October 17, at bait, light and flying by day. Not common as an adult.

Rhodophora Gn.

2941 *R. florida* Gn.

General through southern Nova Scotia, and northward at Great Village, Stellarton and Baddeck. June 29 - July 30. Occasionally common, though very sporadic in its occurrence. The larva feeds on the green seed capsules of *Oenothera.*

Schinia Hbn.

2990 *S. nundina* Dru. Plate XI, Figure 9.

Lawrencetown, Annapolis County, August 24, 1945, at light. Larva reported on flowers of *Solidago.*

3018 *S. arcigera* Gn.

Round Hill, August 5, 1938, August 14, 1939, at light; Digby, September 12, 1937. Rare.

Acontiinae

Cryphia Hbn.

3099 *C. pervertens* B. & McD.

In beech woods at Acaciaville, June 15, July 26, 1949; Annapolis, June 17, 1949; Armdale, July 18, 1945. Not uncommon at light in the Digby County locality; otherwise rare. Bred from elm in Ontario by the Canadian Forest Insect Survey.

Erastria Ochs.

3117 *E. bellicula* Hbn.

Common, especially in bogs, from White Point Beach, South Milford and Lequille to Baddeck and Cheticamp. June 14 - August 7, at light and flushed by day.

3118 *E. muscosula* Gn.

Acaciaville through the Annapolis Valley to Halifax County, and at White Point Beach and Baddeck. Probably general. June 15 - August 8.

3119 *E. albidula* Gn.

General and very common through southern Nova Scotia and at Baddeck. Probably everywhere. June 13 - August 1, frequenting open, grassy places.

3120 *E. synochitis* G. & R.

Generally distributed from Halifax County southward and westward, being especially abundant in Annapolis Valley localities. June 14 - July 25, at light.

3122 *E. concinnimacula* Gn.

Acaciaville, Annapolis Royal and Lake Kejimukujik to Truro, Great Village, Baddeck and Cheticamp. Not taken in Halifax County. May 30 - July 20. Scarce.

3124 *E. carneola* Gn.

Annapolis Valley region from Digby to Kentville, and at Truro, White Point Beach and near Halifax. June 5 - September 13, at light. Common. Reported on *Rumex*.

Neoerastria McD.

3126 *N. apicosa* Haw.

Annapolis, White Point Beach, Petite Riviere, Armdale, MacNab's Island, Bass River, Baddeck. June 12 - September 9. Common.

Capis Grt.

3129 *C. curvata* Grt.

Generally distributed north to Baddeck. June 15 - August 28, at light. Often commonest in bogs, though not restricted to this type of habitat.

Tarachidia Hamp.

3176 *T. candefacta* Hbn.

Lequille and Round Hill, Annapolis County, Grand Pré, Kings County. June 8 - July 5, and August 28. Rare and local. Larva reported on *Ambrosia.*

Euteliinae

Marathyssa Wlk.

3223 *M. inficita* Wlk. Plate XI, Figure 10.

Lequille, June 16, 1949; Round Hill, July 29, 1940. Rare. Larva on *Rhus.*

Paectes Hbn.

3225 *P. oculatrix* Gn. Plate XI, Figure 2.

Lequille, Annapolis County, June 11 - July 6, 1946-49. Quite common at light in oak, ash and hemlock woods bordering the Lequille Brook, one mile from Annapolis Royal. Apparently very local.

Nycteolinae

Characoma Wlk.

3234 *C. nilotica* Rogenh.

Great Village, August 8, 1947, at light. Determined by Dr. Brower for the collector, Mr. A. D. Hall.

Nycteola Hbn.

3235 *N. frigidana* Wlk. Plate XI, Figure 11.

Mount Uniacke, May 19; MacNab's Island, September 19; Baddeck, June 30, at light. Many bred at South Milford, Armdale, Hubbards, Parrsboro and Baddeck, July 11-August 31. The slender green larvae feed on willow, tying the leaves together with silk, and these nests are often conspicuous on the shrubby willows in June and July. Even where the species is known to be common, adults very rarely come to light.

Baileya Grt.

3238 *B. doubledayi* Gn.

General and not uncommon through southern Nova Scotia and northward at Baddeck. June 3 - July 21. Several bred from yellow-striped, green larvae on alder.

3239 *B. ophthalmica* Gn.

Annapolis, Lake Kejimukujik, Centreville, Mount Uniacke, Port Wallis, Lakeview, Waverley. May 29 - July 4, in oak or beech woods. Scarcer than *doubledayi*. Larva reported on ironwood and beech in Ontario.

Plusiinae

Syngrapha Hbn.

3246 *S. microgamma* Hbn. Plate X, Figure 5.

Flying by day on bogs in the Prospect Road area, about seven miles from Halifax; ten specimens taken, many others seen—extremely hard to capture. Also seen on the barrens near Peggy's Cove. Two additional specimens taken at light, one in each locality. June 13-July 26, 1945 - 52. These are large specimens, and represent a race or species distinct from *montana* Pack. of the White Mountains and Gaspé regions.

(3254) *S. rectangula* Kby.

General from Digby, Lequille, White Point Beach to Stellarton and Baddeck. Probably everywhere. July 3 - August 16, at light, flying by day, and often visiting flowers of thistle, dogbane, etc. along with Sphingidae at dusk and after dark. Bred by the Dominion Forest Insect Survey from larvae on spruce and balsam fir.

(3257) *S. alias* Ottol.

Taken in many scattered localities from Barrington Passage to Whycocomagh and Baddeck. July 11 - August 30, mostly at light. Not quite as common as *rectangula*. Bred from spruce by the Dominion Forest Insect Survey.

(3259a) *S. altera variana* Ottol. Plate X, Figure 6.

White Point Beach, Armdale, MacNab's Island, Stellarton. July 15 - August 28, at light. Quite rare. *Variana* was described from Saint John, N. B.

(3260) *S. octoscripta* Grt. Plate X, Figure 7.

White Point Beach, Barrington Passage, Round Hill, Mount Uniacke and near Halifax. July 6 - September 20, mostly in August. Scarce. It was bred at Ottawa from a larva on *Vaccinium*.

(3263) *S. surena* Grt. Plate X, Figure 8.

Only one specimen of this rare species seen, a female taken on French Mountain, Inverness County, August 20, 1952 (W. Harrington).

(3264) *S. epigaea* Grt.

White Point Beach, Annapolis, Round Hill, Auburn, vicinity of Halifax, Parrsboro. June 15 - August 29. Common at light some seasons at Armdale. Bred June 29, 1951 from a larva on *Myrica gale* at Mount Uniacke. Also reported on *Vaccinium*.

(3266) *S. selecta* Wlk.

Digby, Lequille, Mount Uniacke, Armdale, MacNab's Island, Truro, Glenville, Baddeck. July 24 - September 7. Scarce. I have seen a specimen supposed to have been bred from white spruce (Canadian Forest Insect Survey), but the reliability of such host plant data on individual specimens beaten from conifers is always questionable.

Anagrapha McD.

(3252) *A. falcifera* Kby.

Kirby, "Fauna Boreali-Americana: Insecta". See also "Insects of the Northern Parts of British America", by Rev. C. J. S. Bethune, p. 149.
Type locality: Nova Scotia (Type collected by Dr. McCulloch).

General in grassy areas from White Point Beach and Annapolis to Cape Blomidon, Parrsboro and Stellarton. Probably in suitable locations everywhere. Two broods, May 31 - July 3 and July 21 - September 22. Common. Form *simplex* Gn. possibly seasonal, and referring to the summer generation.

Trichoplusia McD.

(3269a) *T. ni brassicae* Riley

Annapolis, White Point Beach, Armdale, MacNab's Island, Cole Harbour. June 30 - September 28. Locally common. As its name implies, the American race *brassicae* is sometimes an injurious pest on cultivated Cruciferae, but apparently it has never been recognized as such within our area.

Pseudoplusia McD.

(3280) *P. oo* Cram. Plate XI, Figure 12.

Armdale, September 5, 1945; Wellington, Halifax County, October 12, 1950. Rare.

Rachiplusia Hamp.

(3289) *R. ou* Gn.

Cole Harbour, July 13, 1951, at light. One male, determined by genitalia.

Chrysaspidia Hbn.

(3273) *C. putnami* Grt.

Locally common in grassy places from White Point Beach, Digby and Annapolis to Parrsboro, Great Village, Stellarton and Baddeck. June 27 - August 17, at light and flushed by day.

(3304) *C. venusta* Wlk.

Round Hill, MacNab's Island, Cole Harbour, Great Village, Stellarton, Baddeck. July 3 - August 9. Local.

Autographa Hbn.

(3265) *A. ampla* Wlk.

White Point Beach and Digby to Three Brooks, Pictou County and Baddeck. July 6 - August 29. Common. Bred at Armdale, June 17, 1951 from a stout, bright green larva on alder. Also reported on blueberry (Canadian Forest Insect Survey).

(3272) *A. rubida* Ottol. Plate X, Figure 9.

Truro, June 23, 1927 In the (Canadian National Collection); Centreville, June 2, 1951, at light. Very rare.

(3279) *A. biloba* Steph.

Digby, Round Hill, Armdale, MacNab's Island, Petite Riviere, August 14 - October 29. Rare.

(3281) *A. precationis* Gn.

Generally distributed and commonest of the *Autographas*. Two broods, June 12 - July 8 and July 15 - October 17. The larva has been reported on a variety of low plants, such as *Plantago* and *Taraxacum*.

(3285) *A. bimaculata* Steph.

Generally distributed and common through southern Nova Scotia north at least to Stellarton. July 9 - August 24.

(3286) *A. mappa* G. & R. Plate X, Figure 10.

Various localities from Barrington Passage to Truro and Glenville; also present at Dorchester, N. B. Seems well distributed through western Nova Scotia but occurs sparingly. June 19 - August 11, at light.

(3291) *A. flagellum* Wlk.

Barrington Passage, Digby, Annapolis, White Point Beach, Petite Riviere, Mason's Point, Halifax, Cole Harbour, Great Village and French Mountain Inverness County July 3 - September 5, at light. Not common.

Chrysanympha Grt.

(3305) *C. formosa* Grt.

White Point Beach and Acaciaville to Glenville, Cumberland County and Baddeck. July 12 - August 17, at light. Locally common. Larva on *Vaccinium.*

Eosphoropteryx Dyar

(3300) *E. thyatiroides* Gn.

Digby, Acaciaville, Waverley, Armdale, MacNab's Island, Chignecto. July 26 - August 23, at light and visiting flowers at dusk with other Plusiinae. Usually scarce. Supposed to feed on *Thalictrum.*

Pseudeva Hamp.

(3301) *P. purpurigera* Wlk.

White Point Beach, Acaciaville, Lequille, Port Wallis, Stellarton. July 13 - August 27, at light. Local.

Plusia Ochs.

(3295) *P. aereoides* Grt.

White Point Beach and Annapolis to Truro, Stellarton and Baddeck. June 30 - August 5, at light. Widely distributed and quite common in some localities. Larva reported on *Spiraea* (Thaxter).

(3297) *P. balluca* Geyer

Digby, 1904; MacNab's Island, August 20, 1907; "Nova Scotia. From Lieut. Redman's collection" (Walker). Rare. Larva on *Humulus.*

Abrostola Ochs.

3307 *A. urentis* Gn.

Great Village and Glenholme, Colchester County. June 26 - July 29, at light. Common in that general area, judging by the number of specimens seen.

Catocalinae

Catocala Schrank

3316 *C. antinympha* Hbn.

Many records from Digby and White Point Beach to Fenwick and Glenville, Cumberland County and Three Brooks, Pictou County.

July 23 - September 17. One of the commonest species of *Catocala* wherever the food plant, *Comptonia*, grows. The larvae are readily swept or beaten from sweet fern bushes in early summer.

3317 *C. coelebs* Grt.

Taken in numerous localities in the counties of Digby, Annapolis, Halifax, Queens, Cumberland, Pictou, Antigonish and Victoria. August 1 - September 21, at bait. Not very common. Bred from larvae on sweet gale on the Mount Uniacke bogs and at Baddeck, and on bayberry at Halifax. The adults of *coelebs*, like most of the *Catocalas*, became widely dispersed, and may often be taken long distances from the nearest colony of the food plant.

3338 *C. subnata* Grt. Plate XII, Figure 1.

Taken at bait in Fleming Glen, a Halifax park bordering the North West Arm opposite the city, August 13, 1944. One male in very fresh condition. Food plant unknown, but supposedly walnut, butternut or hickory, none of which is native to Nova Scotia.

3342 *C. ilia* Cram.

Including form *conspicua* Worth. Digby, Lequille, Lake Rossignol, Coldbrook, Halifax. July 23 - August 30, and once (Digby) September 31. Not uncommon some seasons in Fleming Glen, Halifax, and in the oak woods of the Annapolis Valley region. Despite their large size, the larvae of *ilia* must mature very quickly, as it is one of the earliest species to appear. Food plant: oak.

3343 *C. cerogama* Gn.

Digby, August 25, 1906; Fleming Glen, Halifax, August 11, 12 and 24, 1944. Rare. The food plant is *Tilia americana*, which is not a native tree in Nova Scotia. In this area *cerogama* might have transferred its attentions to the widely planted European Linden, *Tilia glabra*.

3344 *C. relicta* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 13, p. 1192, 1857.
Type locality: Nova Scotia.

Numerous records from Yarmouth and White Point Beach north to Port Howe and Pictou. Probably present everywhere, including Cape Breton, but missed through inadequate late summer collecting. August 9 - October 15. One of the commonest *Catocalas* at bait; *clara* Beut. and *relicta* in about equal numbers, the gray form *phrynea* Hy. Edw. scarcer. Larva on poplar.

3346 *C. unijuga* Wlk.

Annapolis Valley from Digby to Centreville, Halifax and vicinity, Truro, Glenville, Fenwick and Three Brooks. July 22 - October 9, at bait. Locally common. Melanic form *agatha* Beut. appears occasionally. Poplar and willow.

3347 *C. parta* Gn.

Digby, Annapolis, Lawrencetown, Wolfville, Springhill, Pictou, and frequently in Halifax County. July 31 - October 3. Locally common. Bred from a larva on a shiny-leaved species of willow at Armdale. Probably also on poplar.

3357 *C. briseis* Edw.

Digby, Bridgetown, Aylesford, Armdale, MacNab's Island, Parrsboro, Three Brooks, Baddeck. August 1 - September 20. Scarce. Occasionally as form *briseana* Strand. Larva on poplar and willow.

3361 *C. semirelicta* Grt.

Great Village, 1945 (A.D. Hall). In the Canadian National Collection.

3373 *C. concumbens* Wlk.

White Point Beach and Digby to Parrsboro, Glenville, and Three Brooks. Presumably general. August 2 - September 28. Often one of the commonest moths at bait. Bred from a larva on willow at Halifax. Normally a poplar feeder.

3374 *C. amatrix* Hbn.

Walker mentions three Nova Scotian specimens in the British Museum, from Lieut. Redman's collection (Lep. Het. Brit. Mus., pt. 13, p. 1195, 1857). Poplar.

3385 *C. sordida* Grt.

Widely distributed and common on the Nova Scotia mainland. July 21 - September 11, at light and bait. I have taken up to fifty or sixty specimens at bait in one evening in Fleming Glen, Halifax, but have never met with such numbers elsewhere. Form *metalomus* Mayf., with black inner margin, forms possibly five percent of the population. Larvae reared on blueberry.

3389 *C. coccinata* Grt. Plate XII, Figure 2.

Halifax watershed area, August 21, 1949. One worn male at bait in deciduous woods. Food plant: oak.

3395 *C. ultronia* Hbn.

Digby, Armdale, MacNab's Island, Parrsboro, Stellarton. July 31 - September 14. Common locally at Armdale, much scarcer elsewhere. Larva on Rosaceous trees, possibly *Amelanchier* in Halifax County, *Crataegus* and *Prunus* in other localities.

3396 *C. crataegi* Saund. Plate X, Figure 11.

Sackville, Waverley, Debert, Glenholme, Great Village, Three Brooks. July 29 - August 28, at bait. Scarce and local. On Rosaceous trees—probably *Crataegus*, *Prunus* and *Amelanchier.*

3399 *C. praeclara* G. & R.

Digby, Lawrencetown, White Point Beach, Mount Uniacke, Waverley, Armdale, Peggy's Cove, MacNab's Island. August 1 - September 17, at light and bait. Food plant supposed to be oak.

3401 *C. blandula* Hlst.

Acaciaville and Lequille to Parrsboro, Pictou, Antigonish and Baddeck. July 23 - September 17, at light and bait. Often plentiful, although not present everywhere. Probably on the same food plants as the very similar *crataegi.*

3411 *C. connubialis* Gn. Plate X, Figure 12.

Oak woods at Lequille, July 25, 26, 1949 (three specimens, one of them at light); Round Hill, September 5, 1939; Coldbrook, July 23, 1949 (bait); oak woods at Lake Rossignol, Queens County, August 24, 1951, two specimens at light; Armdale, August 4 (seen) and August 12, 1944, at bait. Larva on oak.

Parallelia Hbn.

3422 *P. bistriaris* Hbn.

Generally distributed and usually plentiful. May 27 - August 21, most commonly at bait. Larva on maple.

Caenurgina McD.

3431 *C. erechtea* Cram.

Generally distributed and common in grassy areas, including open bogs and marshes. Two broods, May 13 - August 9 and July 27 - August 25. Most commonly flushed by day, but will come to both light and bait. Larva probably on grasses in this area. In the literature there are numerous reports of the food plant being clover, but perfectly fresh specimens of the small spring form occur here on the sphagnum bogs where there is no clover or other Leguminosae.

Doryodes Gn.

3460a *D. bistrialis grandipennis* B. & McD.

Taken by day on the salt marshes at Wolfville, and near Bass River, Colchester County. July 28 - August 19. Debert, August 6, 1952, at light. I found it common along an old dyke on the marsh just across the railway track from Wolfville.

Zale Hbn.

3474 *Z. lunata* Dru.

Peggy's Cove, Armdale, MacNab's Island. August 19 - November 1, at bait. Scarce. A rather general feeder on deciduous trees and shrubs.

3480 *Z. aeruginosa* Gn.

Digby, Centreville, Bridgewater, Caledonia, Mount Uniacke, vicinity of Halifax, Three Brooks, Pictou County. May 16 - June 22, at bait. Often abundant.

3484 *Z. minerea* Gn.

Digby, Wolfville, Caledonia, Mount Uniacke, vicinity of Halifax, Truro, Three Brooks, Baddeck. May 7 - July 11, and one late record; September 23. Usually the commonest *Zale* at both light and bait, extremely variable in coloring. Larva a general feeder on deciduous trees.

3490 *Z. duplicata* Beth.

Digby, Lequille, Coldbrook, Centreville, Caledonia, Bridgewater, Halifax, Waverley, and seen also from Cumberland County. May 2 - June 17, at bait. Not common. *Duplicata* is a pine feeder, and seems to have been most commonly bred from *Pinus strobus.*

Curious looking examples from Armdale and Waverley may not be *duplicata*, and rather resemble *Z. submediana* form *lemmeri* McD.

3499 *Z. cingulifera* Wlk.

Caledonia, Queens County, May 15, 1951. One male at bait. Kentville, May 17, 1952, at bait.

3501 *Z. horrida* Hbn.

Digby, Annapolis, Caledonia, Armdale, MacNab's Island, Stellarton, Baddeck. May 16 - July 7, and one on September 16. One of the commonest *Zales*, occasionally outnumbering *minerea* at bait. Seems commonest in beech woods.

Erebus Latr.

3525 *E. odora* L.

Yarmouth, June 30, 1906 (E. Chesley Allen); Granville Centre, Annapolis County, August 20, 1907 (V. A. Eaton), Payne collection; Sydney, Cape Breton, about 1900 (Miss Margaret Brown).

Synedoida Hy. Edw.

3565 *S. grandirena* Haw.

Digby, Lequille, South Milford, Lake Rossignol, White Point Beach, vicinity of Halifax, Debert. June 10 - August 25, at light. Abundant in the rich woodland along the Lequille Brook in Annapolis County where a long series was reared from larvae on *Hamamelis*. Larvae were also found commonly on the witch hazel bushes at Lake Rossignol. The larva is slender, tapering, light brown in color, very Catocaline in appearance and behaviour. They feed only at night, crawling to the ground and hiding during the day. Chewed leaves with only the vein network remaining betray their presence.

3578b *S. adumbrata alleni* Grt.

Annapolis Royal, June 27, 1946, at light; Granville Ferry, July 13, 1909 (Payne); Debert, July 9, 1952; Cumberland County, June, 1939 (Hall). Rare.

Anticarsia Hbn.

3590 *A. gemmatilis* Hbn. Velvet Bean Caterpillar.

Round Hill, September 20, 1938; Armdale, September 10, 1943, at bait; Peggy's Cove, September 20, 1952, at light. A casual migrant from the south.

Calpe Treit.

3608 *C. canadensis* Beth.

Acaciaville, Lequille, White Point Beach, Petite Riviere, Halifax watershed area, Shad Bay, Mount Uniacke, Stellarton, Baddeck. June 30 - August 18, at light and bait. Usually scarce, although a number were taken at Lequille. Larva reported on *Thalictrum.*

Scoliopteryx Germ.

3615 *S. libatrix* L.

Taken or observed in numerous localities from Digby through the Annapolis Valley and Mount Uniacke to Halifax, and northward at Glenville, Parrsboro and Stellarton. May 8 - June 20, and July 23 - October 9, at bait. Probably hibernates as an adult. Bred from a larva on willow; also feeds on poplar.

Alabama Grt.

3616 *A. argillacea* Hbn. The Cotton Worm

Armdale, MacNab's Island, Stellarton. October 8 - 18, at bait. A migrant from the south. In 1941 it appeared in abundance at bait, but since then only occasional individuals have been noted.

THE DELTOIDS

The following three subfamilies comprise what were formerly known as the "Deltoid" moths, and are still loosely referred to by that term. They form an interesting group still much in need of careful study. The last extensive revisional treatment of the North American species was that by J. B. Smith (Bull. 48, U.S.N.M., 1895).

Some of the species are obscure and hard to determine, particularly in *Zanclognatha*. *Z. theralis* Wlk. and *minoralis* Sm. have long been confused, but since Walker's name was based on a specimen from Nova Scotia it seems safe to apply his name to our material. All of these small gray *Zanclognathas* taken here probably belong to the one species, although there is considerable variability. The descriptions and figures in Smith's Deltoid Revision being rather inadequate, the true identity of his *minoralis* is still none too certain.

There are four distinct species of *Hypenodes* in Nova Scotia, three of which are new and described in a separate paper still in manuscript. In the present paper I am withholding the new names to preclude any possible confusion of the literature by their untimely appearance in print before the intended original descriptions.

Not a great deal is known about the early stages of the deltoids, but it is apparent that some of them have rather unique feeding habits. Hence the larvae have been generally overlooked by collectors. Many species are scavengers, feeding on dead or even decomposing vegetable matter, and possibly animal matter, rather than on living, green vegetation. Larvae of the southern *Epizeuxis gopheri* Sm. feed in the waste matter and general debris in burrows of the gopher tortoise. Some species may be associated with birds' nests. Others subsist on a diet of fungi or lichens, as shown by Mr. J. G. Franclemont's success in rearing species of *Metalectra* on dead bark and bracket fungi, and *Epizeuxis* on reindeer moss (*Cladonia*). *Bomolocha*, *Lomanaltes*, *Plathypena* and *Hypena* appear to have very ordinary foliage-feeding larvae, but the Thallophyte-feeding *Metalectra* seems to constitute an exception within the Hypeninae. The Rivulinae may be fungus-feeders in some very select habitat according to current belief, but only inspired and systematic rearing work of the sort begun by Franclemont will provide the final answer.

Hypeninea

Pangrapta Hbn.

3650 *P. decoralis* Hbn.

Seems to occur commonly everywhere. Many records northeastward to Cape Canso and Baddeck. May 31 - August 7.

Metalectra Hbn.

3652 *M. quadrisignata* Wlk.

Digby through the Annapolis Valley and Mount Uniacke to the Halifax area, and northward at Bass River, Lakelands and Glenville, Cumberland County, and Baddeck. June 16 - August 18. Moderately common at light and bait. Highly variable in size and maculation.

Spargaloma Grt.

3684 *S. sexpunctata* Grt.

Annapolis Royal, South Milford, Auburn, Coldbrook, Centreville. June 4 - July 27, at light. Scarce, and seemingly confined to the Annapolis Valley region.

Bomolocha Hbn.

3688 *B. baltimoralis* Gn.

Digby and White Point Beach to Pictou and Baddeck. June 12 - August 30. Often common at light; occasionally at bait. Larva on maple.

3689 *B. bijugalis* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 16, p. 32, 1858.
Type locality: Nova Scotia.

Armdale, MacNab's Island, Petite Riviere, Truro, Glenville. July 1 - August 8. Rare.

3690 *B. palparia* Wlk.

Lequille, July 22, 1946, a male; Coldbrook, July 27, 1950, a female. Rare.

3698 *B. toreuta* Grt.

Mount Uniacke, July 6, 1950, one male at light. This is possibly only the male of *B. bijugalis*, since only females of the latter are known, and no one has ever seen a female *toreuta*.

3701 *B. citata* Grt. (*minualis* Gn.?). Plate XI, Figure 13.

Armdale, October 18, 19, 1947. Two specimens at light.

Lomanaltes Grt.

3703 *L. eductalis* Wlk.

Digby and White Point Beach north to Baddeck. Generally distributed and often common at light. June 4 - August 10. Larva slender, bright translucent green, with faint, broken addorsal and dorso-lateral lines and minute tubercles from which emerge short, stiff hairs; common on alder.

Plathypena Grt.

3705 *P. scabra* Fbr.

Armdale, MacNab's Island, Lake Rossignol. August 2 - November 9, at light and flying by day. Locally common, especially in late September and October. Larva on herbaceous legumes.

Hypena Schrank.

3706 *H. humuli* Harr.

Wolfville, Waverley, Armdale, MacNab's Island, Baddeck. June 14 - October 15. Bred from slender green larvae on *Humulus* at Wolfville.

Rivulinae

Dyspyralis Warr.

3716 *D. illocata* Warr.

Acaciaville, July 26, 1949; Lequille, July 25, 1949, quite common at bait in the oak woods; Coldbrook, July 27, 1950; Centreville, July 22, 23, 1949, at bait; Mount Uniacke, August 11, 1950. Seemingly local and mostly in the Annapolis Valley region.

Hypenodes Doubleday (*Menopsimus* Dyar, in part).

3728, 1 *H. fractilinea* Sm.

South Milford, Annapolis, Auburn, Mount Uniacke, vicinity of Halifax, Glenville. June 16 - August 27, at light. Locally common, occurring most frequently in dry, mixed woodland.

3728, 2 *Hypenodes* n. sp. (in MS)

Smaller and better marked than *fractilinea*, and grayer in coloring. Occurs only in bogs or where heathy, acid soil conditions prevail, and is the commonest *Hypenodes* in this region. This may be the smallest Phalaenid species in North America, with an average expanse of only one centimeter. Taken near Lake Rossignol, Mount Uniacke, Waverley, Herring Cove and on bogs in the Prospect Road area near Halifax. June 22 - September 7, at light.

3728, 3 *Hypenodes* n. sp. (in MS)

This is a larger species about the size of *caducus* Dyar, and very dark, the coloring in fresh individuals being very nearly a dull black. June 17 - September 2, at Annapolis, Aylesford, Lake Rossignol, Auburn, Waverley, Glenville and Baddeck. Seems to prefer bogs and cat-tail marshes, although scattered specimens have been taken in other environments.

3728,4 *Hypenodes* n. sp. (in MS)

This is the most distinctive species of *Hypenodes*. It is about the size of *fractilinea*, but has a dark brown median band that contrasts sharply with the paler areas of the wing. Also, the outer boundary of the dark median shade is strongly curved, not straight as in *fractilinea*. Mount Uniacke, Waverley, Halifax watershed area, Prospect Road bog, Herring Cove, West Northfield, Lunenburg County. July 10 - August 18, at light. Another acid bog species, frequenting much the same habitat as 3728,2 but, like that species, turning up occasionally elsewhere. Sometimes common, but highly localized, even within the bogs.

Parahypenodes B. & McD.

3729 *P. quadralis* B. & McD. Plate XI, Figure 14.

Lequille and the Halifax watershed area. July 25 - August 31, at light and bait. Scarce.

Rivula Gn.

3732 *R. propinqualis* Gn.

White Point Beach, Digby, Deep Brook north to Pictou County, but presumably general. July 12 - September 2, at light. Plentiful.

Herminiinae

Epizeuxis Hbn.

3734 *E. americalis* Gn.

Occurs everywhere, including Cape Breton. July 4 - September 11, at light and bait.

3735 *E. aemula* Hbn.

White Point Beach; South Milford, Lequille to Waverley and Armdale, and at Glenville, Cumberland County. Common in the southern portions of the province, especially the Annapolis Valley. July 4 - August 24.

—— *Epizeuxis* sp. Plate XI, Figures 15 & 16.

Close to *aemula* but averaging smaller, and with paler hindwings and often darker forewings. It usually, though not always, has an ochreous orange filling in the reniform, rather than the pale yellow common in *aemula*. Digby, Lequille, through the Annapolis Valley and Mount Uniacke to Halifax, and northward at Bass River and Three Brooks. July 14 - August 23, at light and bait.

Newfoundland, Cape Breton and northern New Brunswick have a darker northern race in which the primaries are strongly suffused with blackish scaling. Baddeck, July 14 - August 8.

This species seems to have a definite connection with spruce, since it has been bred repeatedly from larvae beaten from these conifers by the Canadian Forest Insect Survey. The larvae may feed, at least in part, on lichens growing on the spruce trees.

3737 *E. rotundalis* Wlk. Plate XI, Figure 17.

Acaciaville, Lequille, Mount Uniacke, Waverley, Armdale, West Northfield, Lunenburg County, White Point Beach. July 15 - August 20, at light and bait. Not as common as the following species.

3739 *E. julia* B. & McD. Plate XI, Figure 18.

Lequille, Lawrencetown, Coldbrook, Centreville, Armdale and Glenville. July 12 - 30. Abundant at bait in the Annapolis Valley and Cumberland County, scarcer elsewhere.

In the B. & McD. "Contributions", Vol. 4, No. 2, pl. XVIII, the explanations of Figures 11 and 13 are reversed. Figure 11 is *julia*, not *forbesi*.

3740 *E. diminuendis* B. & McD.

Lequille, Auburn, Coldbrook, Centreville, Petite Riviere, Glenville. June 20 - July 29, at light and more frequently bait. Common where it occurs, but seems totally absent in the vicinity of Halifax.

3742 *E. laurenti* Sm. Plate XI, Figure 19.

Armdale, August 1, 1945, August 21, 1948; Waverley, July 21, 1950 (2). At bait in mixed forest. Described from North Carolina, and before its discovery in a limited area of western New York was considered distinctly southern. Its occurrence in Nova Scotia is therefore surprising.

3746 *E. lubricalis* Gey.

White Point Beach, Lake Rossignol and Digby to Glenville and Three Brooks. July 20 - August 21, at bait. Scarce.

Phalaenophana Grt.

3750 *P. pyramusalis* Wlk.

Lequille, South Milford, Petite Riviere to Baddeck. July 9 - July 26. Common at light in dry, mixed woodland.

Zanclognatha Led.

3752 *Z. lituralis* Hbn.

Waverley, Armdale, Bass River, Colchester County, Glenville, Cumberland County. July 15 - 29, at bait. Scarce.

3753 *Z. theralis* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 19, p. 855, 1859.
Type locality: Nova Scotia.

White Point Beach, West Northfield, Lunenburg County, Armdale, Halifax watershed area, Shad Bay, Mount Uniacke, Baddeck. July 6 - August 10, at light. In boggy country and, more rarely, in dry woods.

3756 *Z. laevigata* Grt.

Acaciaville, July 26, 1949. Four specimens at light in beech woods. Point pleasant Park, Halifax, July 25, 1953.

3759 *Z. pedipilalis* Gn. Plate XI, Figure 20.

Cole Harbour, Halifax County, July 23, 1951. Two specimens at light (W. Harrington).

3760 *Z. protumnusalis* Wlk.

Acaciaville, Lequille, Lake Rossignol to Baddeck and Cheticamp. July 2 - August 12. Seemingly general, but never abundant like *jacchusalis*.

3762 *Z. cruralis* Gn.

Digby, Annapolis, Lawrencetown to the vicinity of Halifax, Cole Harbour and in dry mixed forest in the Cheticamp River valley. June 12 - August 20, at light and bait. Locally common.

3763 *Z. jacchusalis* Wlk.

Occurs commonly in wooded localities everywhere, including Cape Breton. July 10 - September 7, at light and bait.

There has been some confusion in indentity between this species and *ochreipennis* Grt., and the determination of *jacchusalis* is still somewhat uncertain. Nevertheless, Walker included two Nova Scotian specimens in his series of that species when he described it, although the actual type came from the United States, perhaps from Trenton Falls, N. Y.

Chytolita Grt.

3767 *C. petrealis* Grt.

Lequille and South Milford to Armdale, Waverley, Great Village B addeck. June 12 - July 18, at light. Common.

Philometra Grt.

3770 *P. metonalis* Wlk.

Widely distributed north at least to French Mountain, Inverness County, but never very common. June 29 - August 14, at light.

3772 *P. hanhami* Sm. Plate XI, Figure 21.

Acaciaville, Lequille, Centreville, Mount Uniacke, Halifax watershed area. July 19 - August 21, at light. Occurs very sparingly in a variety of habitats, ranging from sphagnum bogs to dry, deciduous forest.

Hormisa Wlk.

3773 *H. absorptalis* Wlk.

White Point Beach, Lequille, to Oxford, Cumberland County, Bass River, Parrsboro, Stellarton and Baddeck. Presumably general. June 30 - August 4, at light and flushed by day from low vegetation, chiefly in marshy situations.

3776 *H. orciferalis* Wlk.

White Point Beach, Acaciaville, Mount Uniacke bogs, Armdale, Bass River. July 15 - 26, at light. Infrequent.

Renia Gn.

3789 *R. flavipunctalis* Geyer

White Point Beach and Digby north to Glenville and Baddeck. July 7 - August 22, at light. Locally common in deciduous woods, but seems to avoid the Halifax area.

3793 *R. sobrialis* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 16, p. 228, 1858.
Type locality: Nova Scotia.

Generally distributed and more plentiful than *flavipunctalis*, and more inclined to be an acid soil species. July 7 - August 20. Very common in the coniferous forest and bog country near Halifax.

Bleptina Gn.

3797 *B. caradrinalis* Gn.

Generally distributed and common on the mainland; no records for Cape Breton but almost certainly should occur there. Seems to require no special habitat as far as the adults are concerned. June 22 - August 9.

Palthis Hbn.

3807 *P. angulalis* Hbn.

Digby, Lequille, Lake LaRose, Annapolis County to the vicinity of Halifax, Cole Harbour, Mount Uniacke, and Stellarton. June 5 - July 31, at light. Widely distributed but not common.

NONODONTIDAE

(Forbes and Franclemont arrangement)

Melalophinae

Melalopha Hbn.

3822 *M. apicalis* Wlk.

Digby, Annapolis, Petite Riviere, vicinity of Halifax, Great Village, Three Brooks, Baddeck. May 28 - July 26. Evidently single brooded. Bred from a larva on willow.

3826 *M. strigosa* Grt.

Acaciaville, South Milford, Annapolis, Auburn, vicinity of Halifax, Bass River, Three Brooks, Baddeck. June 11 - July 17, at light. Sometimes common in or near groves of aspen, the larval food plant.

3827 M. *albosigma* Fitch

Generally distributed and usually the commonest species of *Melalopha*. Two broods: May 9 - July 31, and July 30 - September 3. The pale spring form (possibly var. *specifica* Dyar) abundant in deciduous woods near Halifax. Summer form scarcer, indicating only a partial second generation. A second brood specimen bred from a larva on aspen at Londonderry, Colchester County.

Phalerinae

Datana Wlk.

3829 *D. ministra* Dru.

Acaciaville and White Point Beach through the Annapolis Valley and Halifax County to Great Village, Pictou and Baddeck. Probably everywhere. June 12 - August 4. Very plentiful, the larvae feeding mostly on oak and apple. Nova Scotian specimens vary greatly and tend to have a more granulate appearance than is normal farther south.

3830 *D. angusii* G. & R.

Annapolis Royal, Armdale, Great Village, Baddeck. June 14 - August 10. These are redder than normal *angusii* and may not really be conspecific; yet in series they seem distinguishable from our other species. In the absence of walnut and hickory *angusii* probably has an alternative food plant.

3831 *D. drexeli* Hy. Edw.

Several larval colonies on *Hamamelis* at Lowe's Landing, Lake Rossignol, August 23, 1951. Pupae from these failed to survive overwintering, so no reared adults are available for study. A series of males taken at Auburn, June 30, 1951 probably belong here, but some of them run very close to *major*. *Drexeli* is most commonly known as a *Vaccinium* feeder.

3832 *D. major* G. & R. Plate XIII, Figure 1.

Annapolis, Armdale, Shad Bay, Waverley, Mount Uniacke, Great Village, Baddeck. June 28 - July 27, at light. Determined by the male genitalia, on comparison with the figures given by Forbes. No larvae seen. Farther south *major* feeds on Andromeda (*Neopieris mariana*) and highbush blueberry (*V. corymbosum*).

Notodontinae

Gluphisia Bdv.

(3939) *G. septentrionis* Wlk.

Generally distributed and common, but never seen in such abundance as *G. avimacula*. May 31 - August 13. Larva on aspen.

(3940) *G. lintneri* Grt. Plate XII, Figure 4.

Debert, Colchester County, May 19, 1952 (W. Harrington), and another specimen in the C. B. Hills collection from Stellarton, without date. In areas where it is better known, *lintneri* flies earlier in the spring than *avimacula*, although their flight periods do overlap. Presumably an aspen feeder.

(3940,1) *G. avimacula* Hudson. Plate XII, Figure 3 and Plate XIII, Figure 4.

Lake Kejimukujik, Smith's Cove, Auburn, Coldbrook, Centreville, Mount Uniacke, vicinity of Halifax, Glenholme, Pictou, in stands of poplar. May 22 - July 3. One of the commonest Notodonts. I have seen almost one hundred specimens of this species come to light in one evening (Centreville).

The striking gray and black form *slossoniae* Pack. occurring along with the normal form at Armdale, Mount Uniacke, Lakeview, Halifax County, Centreville, Bridgewater, Smith's Cove and Lake Kejimukujik, but much scarcer. Both males and females of *slossoniae* occur.

The early stages of *avimacula* are unknown, but the adults are invariably associated with aspen.

Nadata Wlk.

(3857) *N. gibbosa* A. & S.

Generally distributed and moderately common. June 17 - August 7. Bred from larvae on oak and birch, and a larva seen feeding on *Acer platanoides*.

Lophodonta Pack.

(3854) *L. angulosa* A. &. S.

South Milford, Lequille, Round Hill, Centreville, Bedford, Armdale, Prospect Road area, Petite Riviere. June 12 - August 10. Scarce, except in the oak woods of the southern counties. Bred *ex ovo* on oak from a female taken at Centreville.

(3853) *L. ferruginea* Pack.

White Point Beach, South Milford and Lequille to Northumberland Strait and in Cape Breton to the Cheticamp River. Common and apparently general. May 31 - August 5. Larva on birch.

Peridea Stephens

(3849) *P. basitriens* Wlk.

Acaciaville, Annapolis Royal, Mount Uniacke, Glenholme, Great Village. June 29 - August 28. Usually quite scarce, although Mr. Hall took it commonly at Great Village. Early stages unknown. I tried in vain to get young larvae started on almost every likely tree or plant I could think of, including even ferns, since Mr. D. J. Lennox of Jefferson, N. H., reared one from a larva that he thought had been feeding on *Dennstaedtia* (Hay-Scented Fern).

Odontosia Hbn.

(3847) *O. elegans* Strecker

Annapolis, Greenwood, Armdale, Glenville, Three Brooks. June 12 - July 29, at light. Scarce and local. A number came to my lights on a warm, rainy night at Glenville, July 8, 1950. Reared on poplar (Franclemont).

Pheosia Hbn.

(3851) *P. rimosa* Pack.

Generally distributed and plentiful in some localities. Fluctuates greatly in numbers from one season to another. Mostly in August, some in July; once as early as June 3, and a straggler as late as September 24. The mauve colored larva, with small, black, Sphingid-like caudal horn, on poplar and willow in late summer.

Notodonta Ochs.

(3850) *N. simplaria* Graef Plate XIII, Figure 3.

Annapolis Royal, July 31, 1946; Lake Rossignol, August 20, 1951; Centreville, June 4, 1949. Rare. Larva on poplar (Franclemont).

(3843) *N. stragula* Grote

Digby, Annapolis, Round Hill, Waverley, MacNab's Island, Cole Harbour, Truro, Stellarton. June 13 - July 26. Bred from larvae on willow at Smith's Cove, Digby County and Mount Uniacke.

Nerice Wlk.

(3858) *N. bidentata* Wlk.

Great Village, Colchester County, at light. No date (A. D. Hall). Larva on elm.

Symmerista Hbn.

—— *S. leucitys* Franclemont. Plate XII, Figure 6.

Acaciaville, Lequille, MacNab's Island, Rockingham, Stellarton, Baddeck. June 15 - July 26. Locally common. Determined by the larvae and male genitalia. Bred from larvae on maple at Annapolis.

(3859) *S. albifrons* A. & S. Plate XII, Figure 5.

Lequille, Armdale, MacNab's Island, Stellarton. June 15 - July 2 Scarce. Five specimens only, although evidently seen from Nova Scotia by Franclemont (Can. Ent., Vol. 78, p. 100) Determined by genitalia. An oak feeder.

—— *S. canicosta* Franclemont Plate XII, Figure 7.

Lequille, Mount Uniacke, and Armdale, MacNab's Island, St. Margaret's Bay and Mason's Point, Halifax County. June 22 - August 2. Records in the Canadian National Collection from White Point Beach and Baddeck probably also belong here, but I have not seen the specimens. This is our commonest *Symmerista*. Bred at Annapolis from larvae on English oak. Larva also reported on maple and beech.

Dasylophia Pack.

(3881) *D. thyatiroides* Wlk.

Round Hill, July 10, 1940, July 11, 1939; Great Village, 1945. Rare. Food plant not definitely known, but might be *Robinia*.

Hyparpax Hbn.

(3865) *H. aurora* A. & S.

Truro, July 11, 1927. One female, in the Canadian National Collection. Larva on oak.

Oligocentria H.-S.

(3912) *O. lignicolor* Wlk.

Acaciaville, Annapolis, Wolfville, Bedford, Armdale, Peggy's Cove. Common in the southern counties. June 29 - August 25. Larva on oak, beech, birch.

Schizura Dbldy.

(3927) *S. leptinoides* Grt.

Annapolis Royal, July 17, 1931; Lequille, July 27, 1946; Great Village, 1945 (two); Glenville, July 12, 1949; Stellarton, no date. Rare. Nova Scotian specimens are smaller and paler than normal. Larva on oak and probably other trees.

(3919) *S. semirufescens* Wlk.

White Point Beach and Acaciaville to Glenville and Three Brooks. Often quite common. July 3 - August 17. Larva on willow and birch.

(3921) *S. concinna* A. & S.

Moths taken at Round Hill, White Point Beach, Stellarton and Baddeck, June 1 - July 25, at light. Decidedly rare as an adult, much commoner as a larva (the red-humped apple worm). Colonies of larvae on willow, poplar, apple and bayberry at Smith's Cove, Digby Co., Mount Uniacke, Sackville, Meagher's Grant, Halifax County and Three Brooks, Pictou County. I have tried repeatedly to rear the species through without success. In the fall the larva makes a thin, tough cocoon among dead leaves and other debris on the ground and then hibernates, without actually shedding its larval skin until the spring. Larvae in this state are not overwintered easily, and tend to die during the winter, or else do not have enough strength left in the spring to shed their skins, and soon succumb. Mr. D. J. Lennox of Jefferson, N. H. successfully reared *concinna* in 1952, and the Canadian Forest Insect Survey has bred it through a number of times.

(3924) *S. unicornis* A. & S.

White Point Beach, Petite Riviere and Digby north to Glenville and Baddeck. Common and probably present everywhere. May 31 - August 23. Larva green and brown, with a large thoracic horn-like hump; on willow and cherry. A rather general feeder.

(3920) *S. ipomoeae* Dbldy.

Generally distributed and moderately common. June 29 - August 14. *Ipomoeae* and form *cinereofrons* Pack. in equal numbers, form *telifer* Grt. present but much scarcer. Larva a general feeder on the common deciduous trees.

(3923) *S. badia* Pack.

Generally distributed, including Cape Breton. June 5 - August 14. Common. Larvae in Nova Scotia on *Viburnum cassinoides*.

Heterocampa Dbldy.

(3905) *H. manteo* Dbldy.

Acaciaville, Granville Ferry, Lequille, Truro, Baddeck and various localities in Halifax County. June 29 - August 25. I have found *manteo* common only in beech and oak woods, although elsewhere the larva has also been reported on birch and other trees.

(3908) *H. bilineata* Pack.

Round Hill, Great Village and Baddeck. June 10 - August 22. Rare, except at Great Village where scores of specimens were taken at light by the late Mr. A. D. Hall. Larva on elm.

(3906) *H. biundata* Wlk.

Acaciaville, Lequille, White Point Beach, Petite Riviere, vicinity of Halifax, Glenville, Baddeck. June 8 - August 4. Not uncommon. Larva on maple.

3907 *H. guttivitta* Wlk. Plate XIII, Figure 5.

Walker, Cat. Lep. Het. Brit. Mus., pt. 5, p. 992, 1855.
Type locality: Nova Scotia.

Annapolis and vicinity, Round Hill, Lake Kejimukujik, Coldbrook, Halifax and vicinity, Cumberland County (Hall), Baddeck. May 29 - July 16, mostly in June. The commonest *Heterocampa*. Larvae found on beech, choke cherry and sugar maple were probably this. A general feeder on deciduous trees.

(3902a) *H. umbrata pulverea* G. & R.

White Point Beach, Acaciaville, South Milford, Round Hill, Lawrencetown, Mount Uniacke, Shad Bay, Prospect Road, Halifax County. June 15 - August 2. Rare. Reared *ex ovo* on oak and white birch.

(3891) *H. obliqua* Pack. Plate XIII, Figure 2.

South Milford, Lequille, Round Hill, White Point Beach, Truro. July 6 - August 8. A fine series from the Annapolis County localities. Bred from larvae on oak (*Quercus borealis*) at Lequille.

Macrurocampa Dyar

(3910) *M. marthesia* Cram.

Chignecto Mines, Cumberland County, August 17, 1932 (H. G. Payne). The only Nova Scotian specimen seen. Larva on oak and maple.

Cerurinae

Cerura Schrank

(3934) *C. occidentalis* Lint.

White Point Beach, Lequille, Granville Ferry, Round Hill, Centreville, Armdale. Shad Bay, MacNab's Island, Stellarton, Baddeck. July 5 - August 2. Widely distributed but scarce, most of the records being just single specimens. Larva on willow.

(3935) *C. cinerea* Wlk.

Round Hill, July 8, 1940; Lawrencetown, July 14, 1945; Auburn, June 30, 1951; Armdale, July 1, 1948; Glenholme, June 26, 1952. Rare. Larva on poplar and willow.

(3938c) *C. scolopendrina aquilonaris* Lint. Plate XIII, Figure 6.

Here in the north-east the line of separation between *scolopendrina* and *modesta* is obscure. The adults, at least, run extremely close, and when the specimens have gone greasy, or are even slightly worn, it is often virtually impossible to name them satisfactorily. The specimens I have chosen to place here average larger, and are always whiter than *modesta,* lacking most of the smoky cast in the white areas of the primaries supposedly characteristic of that species. Acaciaville, Lequile, Round Hill, Centreville, Mount Uniacke, vicinity of Halifax, Cole Harbour, Stellarton and Baddeck. July 15 - August 16. Food plant probably willow.

(3937) *C. modesta* Hudson

Many records from White Point Beach and Deerfield, Yarmouth County north to Three Brooks and Baddeck. June 20 - August 12. Commoner than *scolopendrina.* Bred from larvae on willow (McDunnough).

LIPARIDAE

Orgyia Ochs. (*Notolophus* Germar)

3943 *O. antiqua nova* Fitch

Digby, White Point Beach, Halifax, Debert, Parrsboro. August 27 - September 29, flying by day. Fluctuates greatly in numbers. Several years ago this species and *leucostigma* were about equally responsible for the defoliation of linden, Norway maple, elm and other shade trees in Halifax, but since then *antiqua* has become quite rare.

3948 *O. leucostigma* A. &. S.

Various localities from White Point Beach, Lake Rossignol and Digby northward. No doubt general. August 18 - October 9, at light. Appears to be mainly nocturnal. The larvae feed on almost any tree or shrub, including conifers. The females of *Notolophus* are wingless.

Dasychira Hbn. (*Parorgyia* Pack.)

3954 *D. vagans* B. & McD. Plate XIII, Figures 9 and 10.

A very dark race. Lequille, Round Hill, Waverley, Shad Bay, Herring Cove, Great Village, Glenville. July 12 - August 22. Probably a general feeder on deciduous trees.

3955 *D. dorsipennata* B. & McD. Plate XIII, Figure 8.

French Village, Halifax County, a specimen bred from a larva on birch, pupating and emerging in September, 1952. A specimen taken at Auburn, June 30, 1951 is probably also referable to *dorsipennata.* The species of this genus ordinarily hibernate as partly grown larvae.

3961 *D. plagiata* Wlk. Plate XIII, Figure 7, normal form.

White Point Beach, Lake Rossignol and Lequille to Baddeck. July 3 - August 26. Common in coniferous areas. Larva on pine, spruce and fir.

In the Annapolis Valley region there occurs, in company with normal *plagiata*, a form that seems separable, and may eventually prove to be another species. It averages a little larger and is not so brown, presenting a paler, grayer, less contrasty appearance, and the lines are more diffuse. The t.p. line is straighter, tending less to make a sweeping curve around the reniform, which is white or grayish, never brown—or ochreous-tinged as in *plagiata*. Acaciaville, Lequille, Centreville (a long series) July 22 - 26.

Stilpnotia Westwood

3966 *S. salicis* Linn. The Satin Moth.

Annapolis, Lawrencetown, Amherst, Baddeck and the vicinity of Halifax. July 10 - August 6, at light. Larvae occasionally in sufficient numbers in June and early July to defoliate the introduced white poplar (*Populus alba*). Introduced from Europe.

Nygmia Hbn.

3967 *N. phaeorrhoea* Donovan. Brown-tail Moth.

The first known occurrence of this notorious pest in Nova Scotia was a specimen taken at Digby, July 14, 1905, by Mr. John Russell (the specimen is in the Nova Scotia Museum of Science collection). In the years following it increased rapidly and became a serious threat to the fruit growers of the Annapolis Valley until, through the systematic collecting of larval nests, and universal spraying of orchards at the proper season, it was reduced to negligible numbers. There are no records at all for the thirties, but in the decade just past a few males came to light at Armdale, July 24, 1944, and Lawrencetown, Annapolis County, July 10, 1944. Older specimens seen from Deerfield, Yarmouth County, Bear River, localities in Annapolis and Kings counties, Truro, Stellarton and MacNab's Island. July 15 - August 14, 1910, 1913 and 1922.

LASIOCAMPIDAE

Tolype Hbn.

3978 *T. velleda* Stoll.

Round Hill, September 15, 1939, September 21, 1938, October 10, 1936, at light. Larva reported on various deciduous trees.

3987 *T. laricis* Fitch

Digby, Round Hill, Auburn, Grand Pré, Mount Uniacke, Armdale, Peggy's Cove, MacNab's Island, Truro, Debert. August 15 - October 4. Males often common at light, but only one female seen. Larva not confined to larch, judging by the records of the Canadian Forest Insect Survey, but rather a general feeder on conifers.

Malacosoma Hbn.

3989 *M. americana* Fabr. Orchard Tent Caterpillar

Deerfield, Yarmouth County, Digby, Lawrencetown, Centreville, Armdale, MacNab's Island, Truro, Stellarton, Three Brooks. July 10 - 29, the larvae feeding up in May and June. Common locally and sometimes a pest of fruit trees, but rarely as abundant as the following.

3997 *M. disstria* Hbn. Forest Tent Caterpillar.

Including form *thoracicoides* N. & D. Generally distributed throughout the area, including Cape Breton. June 18 - August 9 at light, sometimes in extreme abundance. A serious pest of forest and shade trees generally, but showing a distinct preference for oak and aspen. A major outbreak of the nineteen forties had its starting point at Brickton, Annapolis County, and whole stands of woodland extending for miles along the main highway were completely defoliated. Fortunately *Malacosoma* is heavily parasitized, such outbreaks rarely surviving longer than two years in a given locality. The centres of population density in these colonies keep moving from year to year, and the species is constantly disappearing where it was formerly abundant and invading new territory where it had scarcely been seen for years.

Epicnaptera Ramb.

3999 *E. americana* Harr.

General from Digby and Lake Kejimukujik northward to Truro and Stellarton. Not seen from Cape Breton but presumably present there. May 22 - July 11. Varies in coloration from pale bluish-gray to a deep reddish or purplish brown. Bred from larvae on white birch and alder. Also feeds on poplar and other trees.

THYATIRIDAE

Habrosyne Hbn.

4004 *H. scripta* Gosse

Generally distributed and common. June 5 - August 16, at light and bait. The larva has been reported on *Rubus* and other Rosaceae.

Pseudothyatira Grt.

4007 *P. cymatophoroides* Gn.

In numerous localities from Digby and White Point Beach to Baddeck, the form *expultrix* Grt. being somewhat commoner than the type form. June 27 - August 15, at light and bait. Bred from a larva on birch, but probably a rather general feeder.

DREPANIDAE

Eudeilinea Pack.

4017 *E. herminiata* Gn.

Annapolis Royal, June 13, 1949, July 24, 1946; Cheticamp River Valley, July 2, 1949. Rare. Larva on shrubby species of *Cornus.*

Oreta Wlk.

4019 *O. rosea* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 5, p. 1164, 1855.
Type locality: Nova Scotia.

Common in suitable areas throughout, including in smaller numbers the form without the yellow bands, *irrorata* Pack. June 7 - August 28, with stragglers as late as October 10 and November 3. Larvae sometimes plentiful on *Viburnum cassinoides.*

Drepana Schrank

4020 *D. arcuata* Wlk.

Walker, Cat. Lep. Het. Brit. Mus., pt. 5, p. 1164, 1855.
Type locality: Nova Scotia.

White Point Beach and Digby to French Mountain, Inverness County. Common. Two broods: May 19 - July 22 and July 26-August 28. Larva on birch and alder.

4021 *D. bilineata* Pack.

Numerous localities from White Point Beach, Lake Kejimukujik, Acaciaville and Digby to Truro, Stellarton, and in Cape Breton at French Mountain, Inverness County. Always a common species at light in the woods near Halifax. Two broods: May 9 - July 23 and July 17 - August 28. The pale, yellow-brown summer generation has been given the form name *levis* Hudson. Larva on birch.

GEOMETRIDAE

Brephinae

Brephos Zinck

4023 *B. infans* Moesch.

Greenfield, Queens County, Coldbrook, Armdale, MacNab's Island, Debert. April 1 - May 16. Abundant in the vicinity of Halifax from 1943 to 1945, then becoming very scarce until 1950-52 when it again appeared in numbers, although not as commonly as before. *Infans* flies on warm, sunny afternoons in early spring and is very local. The moths are strong flyers but seem to limit themselves to certain areas where they follow a regular flight pattern, perhaps across a sunny clearing in birch woods on a southern slope, or through open, scrubby woods. They are not easily captured. The food plant is birch.

Oenochrominae

Alsophila Hbn.

4026 *A. pometaria* Harr. The Fall Canker-worm.

Frequently a troublesome pest of shade and fruit trees, at least in the counties of Halifax, Lunenburg, Queens, and in the Annapolis Valley region from Windsor to Annapolis Royal. Also seen from Digby and Stellarton. Adults October 30 - December 5, and once taken flying in the woods on January 1, 1949. A general feeder on deciduous trees.

Geometrinae

Nemoria Hbn.

4048 *N. mimosaria* Gn.

Generally distributed and common, at least to Baddeck and Cheticamp. June 2 - August 8, mostly in June. Bred from larvae on willow, alder, sweet fern and larch.

4049 *N. rubrifrontaria* Pack.

Common all through the southern part of the province northward to Colchester and Pictou counties. Probably present wherever the food plant grows. June 4 - July 25, at light. Bred many times from larvae on sweet fern, and once from *Myrica gale.* The remarkable larva, closely resembling that of *mimosaria*, is scarcely distinguishable from a brown, withered sweet fern leaf.

Synchlora Gn.

4070 *S. aerata* Fabr.

White Point Beach, South Milford, Auburn, Mount Uniacke, vicinity of Halifax, Glenville, Baddeck. June 30 - August 4, at light. Locally common. Bred from a larva on *Gaylussacia.*

4074 *S. rubrifrontaria* Pack.

From approximately the same localities as the last but a little scarcer. July 8 - August 14. Early stages not known.

Chlorissa Steph.

4087 *C. pistaciaria* Gn.

Annapolis, Auburn, Mount Uniacke, Armdale, Prospect Road area, Halifax County, Debert. June 5 - July 2. Locally common. Often flushed by day on bogs and barrens where it flies in company with *Mesothea incertata.* Occasionally comes to light in dry woodland. Males dark olive green later fading to ochreous orange above; always orange beneath. Fringes orange or brown, sometimes pinkish, Females olive green above, paler green beneath, with fringes concolorous. Larva has been reported on oak, ironwood and basswood.

Mesothea Warr.

4089 *M. incertata* Wlk.

Digby, Aylesford, Wolfville, Mount Uniacke, Three Brooks, Pictou County, and in many spots about Halifax. May 9 - June 13, usually by day. Moths deep, blue-green on emerging, soon fading to buff yellow. Bred from larvae on willow (twice) and sweet fern, although the moths are commonest on blueberry barrens and bogs, where the normal food plant is thought to be *Vaccinium.*

Chlorochlamys Hulst

4095 *C. chloroleucaria* Gn.

Three Brooks, Pictou County, July 25, 1943, one specimen. A fine series at light near the salmon pools, Cheticamp River, Inverness County, July 2, 1949. Larva on blackberry (Forbes).

Sterrhinae

Scopula Schrank

4140 *S. cacuminaria* Morr.

Lequille, Round Hill, Coldbrook, Baddeck. July 9 - 26. Rare and local. Larva will eat lettuce (Franclemont).

4143 *S. junctaria* Wlk. (*quadrilineata* Pack.) Plate XIV, Figure 1.
For the application of the names *junctaria* and *persimilis*, see McDunnough, Can. Ent., Vol. LXXI, p. 188, 1939.

Clementsvale, South Milford, Lawrencetown, Mount Uniacke, Armdale, Stellarton. June 22 - August 2. Not common.

4148 *S. persimilis* Hlst. (*junctaria* Wlk.) Plate XIV, Figure 2.

White Point Beach, Petite Riviere, Acaciaville, South Milford. Annapolis, Mount Uniacke, Waverley, Armdale, Bass River, Parrsboro, Baddeck. June 22 - July 24. Seems commoner than *junctaria.*

4149 *S. enucleata* Gn.

Specimens seen from most of the localities where collecting has been done. June 15 - August 23. Common. Includes forms *adornata* Prout, *mensurata* Wlk. and *relevata* Swett. The larva has been reported on wild cherry.

4158 *S. inductata sobria* Wlk. Plate XIV, Figure 3.

Barrington Passage to Baddeck. Probably everywhere. June 13 - September 12, at light and flushed by day. Essentially a species of bogs and barrens, although sometimes occurring elsewhere. Larva possibly a general feeder on low plants.

Sterrha Hbn.

4195 *S. rotundopennata* Pack. Plate XIV, Figure 4.

South Milford, June 27, 29; Mount Uniacke, June 22; Bog, Prospect Road, Halifax County, June 19, July 3; Ship Harbour, June 24. All in 1951. Locally common, but apparently overlooked previously. Flushed from low shrubbery bordering woods; a few at light.

Pleuroprucha Moesch.

4206 *P. insulsaria* Gn.

Acaciaville, July 26, 1949; Armdale, June 30, July 8, 1945, July 6, 1947, at light. Rare. Larva reported on oak, *Solidago* and *Celastrus* (Forbes). Rupert reports willow as a food plant, the young larvae feeding in the catkins.

Cosymbia Hbn.

4211 *C. pendulinaria* Gn.

Plentiful everywhere from White Point Beach, Petite Riviere, and South Milford to Baddeck. Apparently two broods overlapping, May 20 - September 1. Reared several times from birch and once from bayberry, but the favourite food in this region appears to be sweet fern. The pretty green and black angulate pupa resembles a *Papilio* or Pierid chrysalis in being supported in the same manner by a girdle of silk.

Larentiinae

Carsia Hbn.

4213c *C. paludata thaxteri* Swett **Plate XIV, Figure 5.**

Herring Cove, bog on Prospect Road, Mount Uniacke, Canso, Mountains above Pleasant Bay, Inverness County, Baddeck. June 18 - August 17, usually flushed by day. A few at light. Frequents small, wet, sphagnous bogs and wet margins or pockets of larger bogs. Varies from bluish-gray to pinkish, but smaller and not so well marked as *boreata* Pack. Larva in Europe on *Vaccinium.*

Acasis Duponchel

4221 *A. viridata* Pack. Plate XIV, Figure 6.

Auburn, Coldbrook, Centreville, White Point Beach, Mount Uniacke, Peggy's Cove, Cole Harbour, Parrsboro, Baddeck, and in various localities near Halifax. May 9 - July 3, at light. Bred several times from stout, sluggish larvae in slight webs in the fruiting cymes of *Viburnum cassinoides.* The moth is never common.

Nyctobia Hulst

4223 *N. limitaria* Wlk. Plate XIV, Figures 8 and 9.

Numerous localities from Caledonia, Lake Kejimukujik, Digby and Round Hill to Mount Uniacke, Debert, Stellarton and Cole Harbour. Probably in coniferous woods throughout. April 16 - June 22. Larva on spruce, fir and hemlock. Extremely variable but probably all the one species. It is doubtful if *anguilineata* G. & R. occurs here.

4225 *N. atroliturata* Wlk. Plate XIV, Figure 7.

Walker, Cat. Lep. Het. Brit. Mus., pt. 26, p. 1710, 1862.
Type locality: Nova Scotia.

Digby, Lake Kejimukujik, Greenwood, Mount Uniacke, Waverley, Armdale, MacNab's Island. April 19 - June 13. Scarce.

Lobophora Curtis

4226 *L. nivigerata* Wlk.

Generally distributed and often common. May 19 - July 29, at light. Larva on poplar (Canadian Forest Insect Survey).

Heterophleps H.-S.

4233 *H. triguttaria* H.-S.

Near Portapique, Colchester County, July 17, 1948 (two); Centreville, July 22, 1949. Rare. Larva on maple (Forbes).

Trichodezia Warren

4235 *T. albovittata* Gn.

White Point Beach, South Milford, Coldbrook, MacNab's Island, Gay's River, Three Brooks, Baddeck and Isle Haute, off Cape Chignecto. May 26 - August 19, with no apparent break. The moth is diurnal and frequents rich, damp woodland or partly shaded stream margins with abundant herbaceous vegetation, such as violets, grasses and meadow rue.

Operophtera Hbn.

4239 *O. bruceata* Hulst Plate XIV, Figure 10.

Digby; not common; November (Russell), as recorded in the catalogue of 1909. Presumably that was before the introduction or widespread dispersion of *brumata*, and it therefore seems safe to assume that Russell really took *bruceata* and not the European species. More recently Walter Harrington found *bruceata* occurring commonly at Glenholme and Debert, Colchester County, November 1 - 13, 1951-52, and one of these is figured. The species is thought to feed on Rosaceous trees.

—— *O. brumata* L. Winter Moth.

First recognized as occurring here in 1949, this European species has become thoroughly established and is spreading rapidly. It now has a foothold in the southern coastal district from Hebron, Yarmouth County to Cole Harbour, Halifax County, and in Lunenburg and Queens counties penetrates inland almost to Annapolis County. It also occurs at Windsor. The greatest concentration of *brumata* is in the counties of Lunenburg and Queens where, in Bridgewater and Liverpool, it is a serious pest of shade trees including oak, maple, elm and linden, as well as the fruit trees. The point of introduction seems to have been somewhere in this south shore area, since not until 1947 or 1948 was *brumata* first noticed at Halifax. While still relatively uncommon there it was mistaken by the author for *O. bruceata.*

The adults occur from October 23 to December 19. The larvae hatch as soon as the leaves appear in the spring, and have nearly all pupated by the last week of June—about a week earlier than *Alsophila pometaria*, which often occurs together with *brumata* in infestations.

Epirrita Hbn.

4243a *E. autumnata henshawi* Swett

Digby, Maitland Bridge, Armdale, Cole Harbour, Wellington, Halifax County, Inverness County, Baddeck. October 1 - 21, at light.

Scarce. Female not wingless. On this continent there are reports of the larva on hemlock and larch.

Triphosa Steph.

4244 *T. affirmaria* Wlk.

Mount Uniacke, August 28, 1949; MacNab's Island, September 13, 1909; Glenholme, April 29, May 19, 1952; Chignecto, 1938; Smith's Cove, Digby Co., May 17, 1953. Rare. Larva of the European species on *Rhamnus* and wild plum.

Calocalpe Hbn.

4247 *C. undulata* Hbn.

Acaciaville to Glenville and eastward to Baddeck. Evidently general. June 19 - August 12. Moderately common. Larvae gregarious and tying up terminal shoots of *Prunus serotina* (southern Nova Scotia); otherwise solitary on Rhodora (Halifax), on willow (Gaspé) and Azalea (Martha's Vineyard). It remains questionable whether more than one species is involved.

Eupithecia Curtis

The arrangement and nomenclature follows Dr. McDunnough's recent Revision of *Eupithecia* (see bibliography). Most of the determinations also are his.

(4287) *E. palpata* Pack. Plate XIV, Figure 13.

Acaciaville, Annapolis and Lake Kejumukujik to Halifax and Mount Uniacke, and farther north at Baddeck. May 8 - July 5. The normal, uniformly dark brown form bred from larvae on *Pinus strobus*. Another form, doubtfully conspecific, has a contrastingly reddish-brown median area, occurs in similar numbers and feeds on spruce. Although only three specimens emerged, the test of rearing *ex ovo* suggests that it may be distinct from both *palpata* and *transcanadata*. This spruce feeding form seems to have the genitalia of *palpata*.

(4287,1) *E. transcanadata* MacKay Plate XIV, Figure 14.

Margaret R. MacKay, Can. Ent., Vol. 83, p. 77, 1951.
Types from Kootenay District, B. C.

Acaciaville, South Milford, Lequille, Isle Haute, Bay of Fundy, Centreville, Mount Uniacke, Peggy's Cove, Parrsboro, Baddeck, Cheticamp, and in several places near Halifax. June 2 - July 9. Just as common as *palpata* in most localities. Bred several times from larvae on balsam fir.

Palpata and *transcanadata* are not always easily separated, but part of our material fits fairly well the description of *transcanadata* in maculation, genitalia and/or larval habits. Such specimens are tentatively set aside under this name.

(4288a) *E. columbiata erpata* Pears.

White Point Beach, South Milford, Bridgewater, Mount Uniacke, Armdale, Waverley, Lakeview, Parrsboro. May 21 - July 18, mostly in May and early June. Very local. Choke cherry has been reported as a food plant.

(4266) *E. miserulata* Grt.

Armdale, September 7, 1948, one female. Three bred in late August, 1953 from larvae on *Thalictrum* at White Point Beach (McDunnough). Recorded food plants: *Eupatorium*, *Aster*, *Ptelea* and Oxeye Daisy.

(4267a) *E. misturata frostiata* Swett

Bridgewater, Mount Uniacke, Armdale, Halifax watershed area, Rockingham. Two broods: May 9 - June 16 and August 11 (several). Scarce. It has been reared from larch in the Ottawa region.

(4276) *E. castigata* Hbn.

Generally distributed. Taken in many places, including Baddeck and Cheticamp in Cape Breton. June 3 - July 19. One of the commonest *Eupithecias*. Bred April 7, 1951 from a larva on alder at Sackville, Halifax County.

(4279) *E. albipunctata* Haw. Plate XIV, Figure 15.

White Point Beach, July 5, 1937; Prospect Road, Halifax County, July 2, 1951; Cheticamp River Valley, July 2, 1949. Bred from a larva feeding on the fruit of *Viburnum cassinoides* at White Point Beach (McDunnough). On *Heracleum lanatum* in B. C.

(4283) *E. luteata* Pack.

From South Milford through the Annapolis Valley region and Mount Uniacke to the vicinity of Halifax, and at Lake Kejimukujik, Caledonia, Baddeck, and on Isle Haute, off Cape Chignecto. Probably in coniferous forest everywhere. May 16 - June 30. Larva on spruce, fir, hemlock and larch.

(4280) *E. fletcherata* Tayl.

Acaciaville, Lake Rossignol, Mount Uniacke and scattered localities in Halifax County. Two broods: June 6-27 and July 26-September 3.

Bred April 9, 1951 from a larva feeding on flowers of *Prenanthes trifoliolata* at Purcell's Cove, Halifax County. Previous reports of larvae feeding on spruce and larch suggest that it is a very general feeder.

(4282) *E. bradorata* McD.

White Point Beach, July 21, 1934; Centreville, June 2, 1951; Mount Uniacke, June 15, 1950; Prospect Road area, July 3, 12, 1951; Baddeck, June 29, 1947. Reared from a pupa found on white spruce by the Canadian Insect Survey.

(4320) *E. arceuthata taylorata* Swett Plate XIV, Figure 16.

Apparently not normal *taylorata* but closer to it than anything else. Coldbrook, June 5, 1949; Centreville, June 2, 1951; Aldershot, June 4, 1952 (eleven specimens); Peggy's Cove, July 8, 1951. Always at light near extensive patches of *Juniperus communis*, the probable food plant.

(4319a) *E. satyrata fumata* Tayl.

Lequille, White Point Beach, Mount Uniacke, vicinity of Halifax, Parrsboro, Baddeck, Cheticamp. June 8 - July 15, and August 23. Bred (McDunnough and Ferguson) from larvae in flower heads of *Aralia hispida*, *Thalictrum*, *Viburnum cassinoides*, *Chelone glabra* and *Spiraea latifolia*.

(4332) *E. nimbicolor* Hlst. Plate XIV, Figure 17.

Mount Uniacke bogs, June 7 and 15; Halifax watershed area, May 31, 1952; Bog, Prospect Road. June 19, 1951, June 18, 1952; Peggy's Cove, June 22, 1952. Locally common in bogs. Life history unknown.

(4324) *E. strattonata* Pack.

Annapolis, South Milford, Round Hill, Auburn, Mount Uniacke, Sackville, Halifax watershed area. June 6 - July 19. Usually uncommon. Bred from a larva on alder at Sackville, and reported on *Spiraea*.

(4326) *E. grata* Taylor

A single female was taken by Dr. McDunnough at Baddeck Forks. Cape Breton in July, 1936.

(4323) *E. russeliata* Swett

This is the commonest *Eupithecia* everywhere in Nova Scotia. June 4 - August 17. Most abundant in heathy or acid bog areas or in spruce forest. A number of specimens reared at Halifax from larvae on *Kalmia angustifolia* and *Rhododendron canadense*.

(4330) *E. fumosa* Hlst. (E. *coagulata* Auct., nec Guenée.) Plate XIV, Figure 18.

Acaciaville, Digby County, June 15, 1949. Larva reported on currant in Manitoba.

(4331) *E. coagulata* Gn. (*E. geminata* Pack.)

Lequille, Round Hill, Aylesford, White Point Beach, Bridgewater, Armdale, Mount Uniacke, Stellarton. July 18 - September 4. Often present but never very common. Large *Eupithecia* larvae, presumably of *geminata*, on *Aster* and *Solidago* in October at Halifax.

(4333) *E. gelidata* Moesch. Plate XIV, Figure 19.

White Point Beach, July 29 - August 11, 1934-35 (McDunnough); Bog on the Prospect Road, Halifax County, July 2 - August 11, 1951; Peggy's Cove, August 20, 1952, at light. A boreal species occurring in the bogs. Supposed to have been bred from a larva on birch in Victoria County (Canadian Forest Insect Survey).

(4335a) *E. perfusca youngata* Tayl.

White Point Beach, Armdale, Mount Uniacke, Baddeck. June 26 - August 14. Locally common. Nothing is known of the early stages.

(4348) *E. filmata* Pears. Plate XIV, Figure 20.

MacNab's Island, Point Pleasant Park, Rockingham and other localities near Halifax, and at Aldershot, Kings County and Caledonia, Queens County in spruce and hemlock woods. April 23 - May 21. Larva on spruce, fir and hemlock.

(4346) *E. annulata* Hulst.

A single specimen, very large for *filmata*, may belong under this name. MacNab's Island, April 29, 1906. Supposed to feed on spruce and *Pseudotsuga*.

(4342a) *E. sobrinata interruptofasciata* Pack.

White Point Beach, Lake Rossignol, Aylesford, Coldbrook, Centreville, Mount Uniacke, Peggy's Cove, Armdale, Cole Harbour. August 23 - October 16, at light. Locally common. Hundreds came to the gasoline lanterns on the barrens near Peggy's Cove. Larva on *Juniperus communis*.

(4366) *E. albicapitata* Pack. Plate XIV, Figure 21.

South Milford, MacNab's Island, Point Pleasant Park (Halifax), Baddeck. June 14 - 30. Very local. Taken in series at South Milford, where the moths were flushed by day in one very restricted area along a road through mixed spruce, fir and pine woods. "Probably will be found to feed in pine cones or *Chermes* galls on conifers as does its European relative" (McDunnough).

(4367) *E. mutata* Pears.

Digby, South Milford, White Point Beach, Baddeck, Margaree Harbour. June 19 - July 15. Scarce. No breeding records known, but presumably the larvae will be found feeding in the young cones of various conifers (McDunnough).

(4389) *E. anticaria* Wlk. Plate XIV, Figure 23.

Walker, 1856. Cat. Lep. Het. Brit. Mus., pt. 24, p. 1241, 1862. Type locality: Nova Scotia.

Many records from Digby and White Point Beach north to Pictou, Guysborough and Baddeck. June 7 - August 7. Moderately common. The slender green larva with bright scarlet lateral stripe often found feeding in the flower heads of *Spiraea latifolia.* It is quite unlike all other known *Eupithecia* larvae in this area.

4383 *E. ravocostaliata* Pack. Plate XIV, Figure 22.

Mount Uniacke, bred April 10, 1952 from a larva on *Viburnum cassinoides.* Another record from Great Village, without date, determined for Mr. Hall by Dr. T. N. Freeman.

Horisme Hbn.

4393 *H. intestinata* Gn.

Acaciaville, Lequille, Coldbrook, Centreville, Bridgewater, MacNab's Island, Baddeck. June 16 - August 8. Locally common, although unaccountably absent in many localities.

Eustroma Hbn.

4398 *E. semiatrata* Hlst.

For usage of the name *semiatrata* see McDunnough, Can. Ent,. Vol. 75, p. 211.

White Point Beach, Digby, MacNab's Island, Baddeck. July 18 - August 20. Rather common at light on a beech and spruce covered hillside near Baddeck, but otherwise rare, Larva reported on *Epilobium* in British Columbia. (Dyar).

Lygris Hbn.

4401 *L. diversilineata* Hbn. Lesser Grape Vine Looper.

Annapolis, Lequille, Halifax, Debert. August 16 - September 15. Bred from a larva on *Ampelopsis.*

4401,1 *L. gracilineata* Gn. Greater Grape Vine Looper.

Bridgewater, Armdale, MacNab's Island, Great Village, Baddeck. July 28 - October 8, mostly in September. Commoner than the last. Supposed, like *diversilineata*, to feed on grape and Virginia creeper.

4402 *L. propulsata* Wlk. Plate XV, Figure 2.

Shad Bay, Halifax County, July 27, 29, 1952; Baddeck, July 22, 1938; North Mountain, August 2, 1953; outer end of Crescent Beach, July 19, 1953. Probably a willow feeder.

4403 *L. testata* Linn.

Lequille, Round Hill, Auburn, Aylesford, Coldbrook, Mount Uniacke, Waverley, French Village, Armdale, Sackville, Cole Harbour, Debert, Great Village, Stellarton. August 3 - September 29, at light. Locally common. Larva in Europe on willow and poplar. Here it always seems associated with willow, rather than poplar, although it has not been reared.

4405,1 *L. flavibrunneata* McD., form *unicolorata* McD. Plate XV, Figure 1.

McDunnough, Can. Ent., Vol. 75, p. 214.

Annapolis Royal, August 20, 1924; Round Hill, August 11, 1935. Rare in the east. These specimens agree quite well with the type of *unicolorata* from Lloydminster, Alta. The example figured is from Dorchester, N. B., since the Nova Scotian specimens are in poor condition.

4406 *L. explanata* Wlk. Plate XV, Figure 3.

White Point Beach to Baddeck, and common everywhere. July 20 - August 31. The name *cunigerata* Walker (Cat. Lep. Het. Brit. Mus., pt. 26, p. 1726. Type locality: Nova Scotia) can be used in a racial sense for material from this region. Early stages apparently unknown.

4408 *L. serrataria* B. & McD.

Deerfield, Yarmouth County and White Point Beach to Glenville, Cumberland County and Baddeck. July 23-August 14. Ocasionally common, but in general scarcer and much more local than *explanata.* Early stages unknown.

Diactinia Warren

4410 *D. silaceata* Hbn.

White Point Beach and Digby to Isle Haute off Cape Chignecto, Great Village and Stellarton. Probably quite general. Two broods: May 29 - June 30 and July 26 - September 5. Always occurs sparingly, never in abundance. Larva reported on *Epilobium* and *Impatiens.*

Plemyria Hbn.

4412 *P. georgii* Hulst Plate XIV, Figure 11.

Lequille, Halifax watershed area, Sackville, Debert, Great Village. August 7 - September 6, at light. Scarce and very local. A female bred from alder at Smith's Cove, Digby County (McDunnough).

Dysstroma Hbn.

4413,1 *D. walkerata* Pears.

Baddeck, French Mountain, Inverness County, Glenholme, Halifax watershed area and most frequently on a bog on the Prospect Road, Halifax County. June 30 - July 13. Scarce. Specimens from Cape Breton are normal *walkerata*, but the population occupying southern Nova Scotia is an unnamed race tending towards melanism and reduction or even absence of the orange antemedial and postmedial shades.

4413,2 *D. infuscata* Tengstrom

For the only other published record of this species in North America, see McDunnough, Can. Ent., Vol. 78, p. 77, 1946 (Cameron Bay, Great Bear Lake, N.W.T., July 14).

Nine Nova Scotian specimens agree very well in maculation and genitalia with the single specimen in the Canadian National Collection from Great Bear Lake, but it is still doubtful if these North American examples are really referable to *infuscata.* Baddeck, July 4, 1949; Armdale, July 18, 1949; bog on the Prospect Road, Halifax County, July 2, 3, 1951; Shad Bay, July 27, 1952. Mostly in bogs or boggy spruce forest. I have taken the same species at the Halfway House on Mount Washington, N. H. and at three thousand feet in Jefferson Notch, N. H.

4416 *D. citrata* Linn.

Generally distributed and often quite common. Not seen from Cape Breton but probably missed through inadequate late summer collecting there. August 10 - October 12, at light and bait. The larva in Europe is a general feeder on low plants.

4420 *D. hersiliata* Gn.

Digby, July 22, 1907; Baddeck, August 5, 1948, one worn specimen of variety *cervinifascia* Wlk. Rare. Much commoner northward in New Brunswick, especially as *cervinifascia.*

Thera Stephens

4431 *T. contracta* Pack.

Digby, August 16, September 19, 1907; Acaciaville, July 26, 1949 (two); Round Hill, September 20, 1938; Aylesford, Centreville, Kentville, September 12 - 13, 1951; and in enormous numbers at Peggy's Cove, August 18-20, 1952. Local. Larva on *Juniperus communis.*

4431,1 *T. juniperata* L. (*procteri* Brow.) Plate XIV, Figure 12

Halifax and vicinity, and Sackville, Halifax County, October 19 - November 5, at light. Larvae may be swept or beaten in great numbers from *Juniperus communis* at Halifax in June and July. Bred moths began emerging August 25, continuing well into September. *Juniperata* was probably introduced from Europe accidentally, although it now occurs in Maine, Nova Scotia and Ontario. It was first taken at Halifax in October, 1945.

Hydriomena Hbn.

The eastern species of this genus, particularly those of the difficult *divisaria-frigidata* and *pluviata-transfigurata* groups, have been greatly muddled in most collections. At the time of writing, these are the subject of careful investigation by Dr. McDunnough in preparation for a new revision of the North American species, and his ideas of our Nova Scotian fauna, as far as discretion allows, result in the following treatment.

4465 *H. furcata* Thun., new race in manuscript (McDunnough).
Plate XV, Figure 4.

On the coastal barrens near Peggy's Cove, Halifax County, August 18, 20, 1952. Eight specimens at light. Normally on willow in Europe, but in the absence of willow is supposed to take to *Vaccinium* and other heath plants. This may be the case at Peggy's Cove, where there is little or no willow. Taken there again, August 30, 1953.

4476 *H. frigidata* Wlk. Plate XV, Figure 5.

Walker, Cat. Lep. Het. Brit. Mus., pt. 26, p. 1729, 1862.
Type locality: Nova Scotia.
See also McDunnough, American Museum Novitates, No. 1535, Nov. 8, 1951.

Barrington Passage, South Milford, Annapolis, Auburn, Isle Haute, off Cape Chignecto, Mount Uniacke, Armdale, Halifax, MacNab's Island, Cole Harbour, Port Wallis, Baddeck. June 6 - July 21. Localized in spruce and fir woods, these trees apparently constituting the host plants of the larvae. There is a uniformly black, melanic male, probably belonging here, from Point Pleasant Park, Halifax.

Frigidata may be only a pinkish-brown race of *divisaria* occupying southern Nova Scotia, but is being kept separate for the present. It is extremely variable in size and coloration.

4477,1 *H. transfigurata* Swett Plate XV, Figure 6.

Annapolis Royal, June 29, 1946; Lequille, June 13 - 14, 1949; Round Hill, two specimens in the Canadian National Collection taken in late May. A total of only six specimens seen. The Lequille specimens came to light in oak and pine woods. There is a record of *transfigurata* being bred from a larva on pine.

4478 *H. perfracta* Swett

Acaciaville, Annapolis, Greenwood, Auburn, Waverley, Lakeview, Halifax County, Armdale, Debert, Chignecto, Baddeck. May 22 - July, at light. Scarce. Apparently a poplar feeder.

4484 *H. divisaria* Wlk.

South Milford, Parrsboro, Three Brooks, Baddeck. June 21 - July 17. Mainly in northern Nova Scotia where it connects up with the population of adjacent New Brunswick. These specimens are not a perfect match for typical *divisaria* from Quebec, but are reasonably close. Larva on spruce and fir.

4485 *H. renunciata* Wlk.

White Point Beach to Dorchester, N. B. and eastward to Cheti camp, Baddeck and Cape North. The commonest *Hydriomena*. May 16 - August 18. Bred from alder near Halifax. Larva stout, sluggish, smooth-skinned, pale pinkish-brown with diffuse dorsal, addorsal and sub-dorsal lines of a darker shade; in a shelter formed by tying the leaves together.

4492 *H. ruberata* Frey.

Smith's Cove, Annapolis, Auburn, Coldbrook, Centreville, Aldershot, Bridgewater, Mount Uniacke, Waverley, Glenholme, Stellarton. May 17 - July 4. Locally common, once outnumbering even *renunciata* at light in the Centreville locality. Included in lesser numbers is form *variegata* Prout. Larva on willow.

Xanthorhoe Hbn.

4509 *X. lacustrata* Gn.

White Point Beach, Lequille, Aldershot, Centreville, Armdale, Bass River, Baddeck. May 3 - August 25, probably as two broods. Often abundant. Larva on *Impatiens* (Dyar).

4511a *X. designata emendata* Pears.

Acaciaville, Annapolis, Coldbrook, Centreville, Windsor, Armdale, MacNab's Island, Glenholme, Baddeck. Two broods: May 15 - July 2 and July 23 - August 27. Well distributed and common. Larvae have been reared on sweet alyssum. The closely allied *X. gynandrata* Pears. does not seem to occur here.

4513 *X. munitata* Hbn. Plate XV, Figure 8.

Centreville, Mount Uniacke, Parrsboro, Three Brooks, Stellarton, Baddeck, French Mountain, Inverness County. July 6 - August 11, at light on bogs, and in dry, partly coniferous woodland. Scarce and probably near the southern limit of its range. Larva in Europe on various low plants.

4516 *X. ferrugata* Clerk

Digby, Caledonia and White Point Beach north to localities in the counties of Cumberland, Pictou, Victoria and Inverness. Well distributed and moderately common everywhere, especially as form *uniden-*

aria Haw. with the black median area rather than the reddish-brown of the typical form. May 8 - August 25, probably as two overlapping broods. Larva on various low plants.

4527 X. *iduata* Gn.

Digby, South Milford, Mount Uniacke, Waverley, Peggy's Cove, Armdale, MacNab's Island, Ship Harbour, Bass River, Baddeck, French Mountain, Inverness County. June 22 - July 26, at light. Always in or near woods.

4530a *X. abrasaria congregata* Wlk. Plate XV, Figure 7.

South Milford, Mount Uniacke, Waverley, Armdale, MacNab's Island, Bass River, Londonderry, Stellarton, Baddeck, French Mountain, Inverness County. June 26 - August 4. A Hudsonian species always occurring in spruce forest, although the larvae may not be conifer feeders. These specimens agree fairly well with topotypical *congregata* from Newfoundland.

Percnoptilota Hulst

4535 *P. obstipata* Fabr.

Digby through the Annapolis Valley and Mount Uniacke to the vicinity of Halifax, and from various Colchester County localities and Baddeck. Probably everywhere. April 2 - October 3 without a break. Apparently a succession of broods through the summer, and then possibly hibernating as an adult. On *Polygonum* and other low plants (Forbes.)

4536 *P. evansi* McD. Plate XV, Figure 9.

Baddeck, June 29, 1947, two specimens at light. Taken at the edge of an open pasture about two miles from Baddeck along the road to Whycocomagh. Also seen (without date labels) in the A. D. Hall collection from Great Village. A rare species.

Entephria Hbn.

4540 *E. aurata* Pack.

Shad Bay, Halifax County, July 27, 1952, a worn male at light. Near West Dover, Halifax County, July 11, 14, 1953, at light. A specimen in the C. B. Hills collection from Stellarton bears the date June 21, 1922, and another, very worn, is without date.

Mesoleuca Hbn.

4546 *M. ruficillata* Gn.

South Milford, Annapolis, Round Hill, Greenwood, Isle Haute, Armdale, MacNab's Island, Stellarton, Baddeck. June 5 - August 2. Occurs sparingly, most captures being just single specimens. Larva on birch (J. B. Smith).

Epirrhoe Hbn.

4551 *E. alternata* Müller

Digby, Annapolis, Aylesford, Coldbrook, Centreville, Grand Pré, Mount Uniacke, MacNab's Island, Cole Harbour, Bass River, Baddeck, Lake Ainslie, Inverness County. June 5 - August 28. At light, and flushed from marshy meadow vegetation by day. Locally common. Larva on *Galium.*

Spargania Gn.

4555 *S. magnoliata* Gn.

White Point Beach, Petite Riviere, Digby, Lequille, Bridgetown. Centreville, MacNab's Island, Debert, Parrsboro, Stellarton, Baddeck, June 2 - September 2. Bred from *Oenothera* at Petite Riviere (McDunnough). Also reported on *Epilobium.*

Euphyia Hbn.

4558a *E. unangulata intermediata* Gn.

Generally distributed and common. Records from White Point Beach to Stellarton and eastward to St. Peter's and Cheticamp. May 21 - August 28. On Caryophyllaceae (Forbes).

4559 *E. centrostrigaria* Woll.

Round Hill, Aylesford, Peggy's Cove, MacNab's Island, Armdale. June 8, July 10, and September 2 - November 2. Rather rare. Larva has been reported on *Polygonum.*

4561 *E. multiferata* Wlk.

Digby, South Milford, Lake Kejimukujik, Bridgewater, Centreville, Mount Uniacke, vicinity of Halifax. May 25 - July 21. Moderately common at light in mixed deciduous forest. Larva on *Epilobium* in British Columbia (Dyar).

Camptogramma Stephens

4572 *C. stellata* Gn.

Armdale, September 6, 1945, at light. Native to tropical and subtropical America but straying northward. Larva on *Pisonia aculeata* (Nyctaginaceae) in Florida (Forbes).

Eulype Hbn.

4573 *E. hastata* L. Plate XV, Figure 10, *gothicata*.

White Point Beach and South Milford to Stellarton, and eastward to Cape Canso, Baddeck and French Mountain, Inverness County. June 5 - July 17. Quite common some seasons, flying by day. Most frequently as variety *gothicata* Gn., with white band on forewing only, especially on Cape Breton where all examples taken were of this variety. Bred from larvae on white birch and alder.

4574 *E. subhastata* Nolc. Plate XV, Figure 11.

Ketch Harbour and Peggy's Cove, Halifax County, vicinity of Halifax, Mount Uniacke bogs, Baddeck, French Mountain, Inverness County. June 7 - July 21, flying by day. Abundant on bogs and coastal barrens flying about *Myrica gale* and *M. pennsylvanica*, on which the larvae make conspicuous shelters by tying the leaves together. Most specimens are well marked with white, unlike race *stygiata* McD. from the Gaspé.

Perizoma Hbn.

4575 *P. basaliata* Wlk.

Digby, White Point Beach, Annapolis, Mount Uniacke, Parrsboro. Baddeck and general through Halifax County. July 21 - August 20, always in or near woods. Early stages unknown.

Earophila Gumppenberg

4587 *E. vasiliata* Gn.

Lake Kejimukujik, Caledonia, Bridgewater, Smith's Cove, Isle Haute, Wolfville, Halifax and vicinity, Mount Uniacke, Cole Harbour, Three Brooks, Pictou County. April 11 - July 7, but mostly in April and May. Includes form *niveifasciata* Hlst.

Venusia Curtis

4589 *V. cambrica* Curt.

White Point Beach, Armdale, MacNab's Island, Parrsboro, Isle Haute, Stellarton, French Mountain, Inverness County. June 5 - August 12. Not generally common, but may be found in greater numbers in northern Cape Breton. Essentially a species of the boreal forest, occurring in great abundance in the interior of the Gaspé, and above three thousand feet in the White Mountains. Larva on mountain ash.

4592 *V. comptaria* Wlk. Plate XIV, Figure 24.

Walker, Lep. Het. Brit. Mus., pt. 21, p. 406, 1860.
Type locality, Nova Scotia.

Caledonia, Bridgewater, Wolfville, Aldershot, Debert, Mount Uniacke, Waverley, vicinity of Halifax. April 3 - June 8. A common early spring species. No reference to the early stages found.

Hydrelia Hbn.

4595 *H. condensata* Wlk. (*lucata* Gn.)

Nova Scotian material seemingly agrees with that species commonly referred to by these names. Digby, Annapolis, South Milford, Auburn, Mount Uniacke, Waverley, Armdale, Debert, Glenville, Baddeck. June 6 - August 4. Probably just as common as the following.

4596 *H. inornata* Hlst.

Digby, South Milford, Coldbrook, Petite Riviere, Mount Uniacke, Armdale, MacNab's Island, Bass River, Baddeck. June 18 - August 11. Locally common in wooded localities.

4597 *H. albifera* Wlk.

Baddeck, June 22, 1934 (McDunnough); North Mountain, August 3, 1953. Commoner in northern New Brunswick.

Eudule Hbn.

4599 *E. mendica* Wlk.

Digby, White Point Beach, South Milford, Karsdale and Lequille, Annapolis County, Mount Uniacke, Armdale, Bass River, Parrsboro, Stellarton, Three Brooks. June 27 - August 11, at light and flushed by day. A characteristic species of moist woods where there is abundant herbaceous vegetation growing in semi-shade. The larvae are known to feed on violets, *Viola* spp. (Rupert), and there is also a report of them being reared on maple (McDunnough).

Ennominae

Bapta Stephens

4605 *B. semiclarata* Wlk.

Colpton, Lunenburg County, Halifax, MacNab's Island, Big Indian Lake, Purcell's Cove and Fall River, Halifax County, Parrsboro. May 15 - July 7. Locally common, flying by day. Larva on cherry and probably other Rosaceous trees.

4606 *B. vestaliata* Gn.

Taken in various Halifax County localities and at Annapolis Royal, but probably present everywhere. June 1 - July 14, mostly at light. Common. Bred from larvae on mountain ash and plum. Reported also on hawthorn, cherry and apple.

4608 *B. glomeraria* Grt. Plate XV, Figure 12.

Digby, Smith's Cove, Caledonia, Wolfville, Mount Uniacke, Armdale, MacNab's Island. May 7 - June 9, at light. Locally common, but easily overlooked because of its early emergence and short flight period. Larvae being reared *ex ovo* are translucent blue-green with thin whitish dorsal and lateral lines and yellow-green heads. They eat *Prunus* and *Crataegus*, but seem to prefer the latter.

Deilinea Hbn.

4612 *D. variolaria* Gn.

Records from Acaciaville, Digby County north to Stellarton. Often common at light, and probably more widely distributed than the available records indicate. June 5 - August 12. Larva on poplar and willow.

4614 *D. erythemaria* Gn.

Acaciaville and South Milford to Pictou County and Baddeck. June 1 - August 4. Commoner than *variolaria*. Bred repeatedly from larvae on willow, and reported on *Populus tremuloides* (Rupert).

Isturgia Hbn.

4658 *I. truncataria* Wlk.

A common species characteristic of bogs throughout, including Cape Breton. May 17 - July 13. Entirely diurnal. Larva on *Arctostaphylos* in Colorado (Dyar).

Philobia Dup.

4664 *P. ulsterata* Pears.

White Point Beach, Acaciaville, Auburn, vicinity of Halifax, Parrsboro, Glenville, Baddeck. June 6 - July 31. Often plentiful and just as common as the following species in some localities. There is one report of it being reared from a larva on maple.

4665 *P. aemulataria* Wlk.

Generally distributed and common. June 6 - July 22. Reared from larvae on maple by the Canadian Forest Insect Survey.

Semiothisa Hbn.

4670 *S. minorata* Pack.

White Point Beach, South Milford, Annapolis, Centreville, Mount Uniacke, Armdale. May 25 - August 10. Locally common. Larva on pine.

4671 *S. bisignata* Wlk.

Scattered localities in the counties of Annapolis, Queens, Lunenburg, Kings, Halifax and Victoria. May 22 - August 19. Common in pine woods. Bred from larvae on white pine.

4673 *S. bicolorata* Fabr.

Glenville, Cumberland County, July 12, 1949. One male at light. This specimen appears to agree with material of *bicolorata* taken in an area of jack pine near Caraquet, N. B. There is an extensive stand of this pine near the Glenville locality, and it seems likely that *bicolorata* is associated with the hard pines (*Pinus banksiana, P. rigida,* etc.) rather than white pine.

4674 *S. distribuaria* Hbn. Plate XV, Figure 13.

Armdale, July 9, 1945. One female at light. Probably also on hard pines only.

4680,1 *S. dispuncta* Wlk.

Almost certainly not conspecific with *granitata,* which is more southern. Common in coniferous woods everywhere from White Point Beach to Cape North. May 31 - August 25, probably all one brood. Larva on spruce, balsam fir, larch, hemlock and white pine. A well marked pine feeding form with whiter ground color is placed here pending further study. A series of strikingly black melanic specimens, probably of the pine feeder, taken at Armdale, June 5-August 8.

There is still another form, perhaps a good species, of smaller size, very pale ground color, and with the t. p. line regular and almost straight, except where it angles inward to meet the costa. Although no data on the early stages is available, this form seems to be associated with hemlock. It emerges early in the spring and is single brooded in Nova Scotia, double brooded in western New York. Taken at Lequille, Auburn, Bridgewater, Rockingham. May 28 - June 16. A female from Glenville, July 12, 1950, looks the same.

4681 *S. oweni* Swett Plate XV, Figure 14.

Acaciaville, Round Hill, Mount Uniacke, Waverley, Armdale, Truro, Glenholme, Baddeck, French Mountain, Inverness County. June 1 - July 26, at light. Not uncommon in boggy areas or larch swamps, Reared *ex ovo* on larch, and true *oweni* probably feeds on that tree only.

4682 *S. perplexa* McD. Plate XV, Figure 15.

A series of specimens representing this species and compared with the types at Ottawa were taken in an extensive boggy area of black spruce, larch and jack pine near Dorchester, N. B., July 17, 1950, and eggs laid by one of the females produced larvae that were reared on larch. These were taken in the same locality occupied by the colony of *Boloria titania grandis*. A single male *Semiothisa* taken at Glenville, Cumberland County, July 12, 1949 agrees with the Dorchester material and apparently belongs to the same species. The two localities are only twenty-five miles apart.

Perplexa, described from British Columbia, resembles *dispuncta*, but may be separated by its larger size (28 mm), darker ground color and well defined transverse lines in the male. On larval characters it is a good species.

4687 *S. sexmaculata* Pack.

Present in suitable locations everywhere and locally common. May 31 - August 31. Larvae in two very different color forms—green with whitish or yellow stripes, and mottled brown and black—on larch.

4725a *S. neptaria trifasciata* Pack.

Round Hill, June 6 - 10 and July 28, 1935; Aldershot pine barrens, May 9, 1949. Scarce, and seems limited to the Annapolis Valley region. Larva of the British Columbia race reported on poplar, willow and alder.

4726 *S. mellistrigata* Grt. Plate XV, Figure 16.

Acaciaville, June 29, 1951; Round Hill, August 5, 1938; Auburn, June 30, 1951; Coldbrook, June 5, 1949; Debert, June 20, August 4, 1952; Three Brooks, Pictou County, bred February 11, 1945 from a larva on willow. Commoner than *neptaria*, but most of the captures were single specimens.

4738 *S. gnophosaria* Gn. Plate XV, Figure 17.

Lequille, July 24, 1949, at light. One male in good condition. This extends eastward considerably the known range of *gnophosaria*. Larva reported on willow.

Itame Hbn.

(4663) *I.* (*Physostegania*) *pustularia* Gn.

Lake Rossignol to Baddeck. Apparently common everywhere. July 20 - September 10. Larva on maple.

4749a *I. andersoni* Swett

Auburn, Kings County, Glenville, Cumberland County, Baddeck. June 30 - August 2, at light. Abundant all through north-eastern New Brunswick but local in Nova Scotia. Moderately common at Glenville and well established on the heathy barrens of the central Annapolis Valley. Bred from a larva on *Vaccinium* at Coldbrook, Kings County, and bred in series from larvae on the same plant in the Ottawa region (McDunnough).

4751 *I. sulphurea* Pack.

White Point Beach, Bridgetown, Round Hill, Petite Riviere, Mount Uniacke, Stellarton, Guysborough. July 6 - August 18, and a worn male on September 7. Mostly flushed by day in the wet bog margins shared by such species as *Carsia paludata* and *Eulype subhastata*. Supposedly a cranberry feeder, but I reared a number from larvae feeding on *Myrica gale* on the Mount Uniacke bogs.

4752 *I. fulvaria* Vill.

Digby and South Milford to Glenville, Guysborough and Baddeck. June 7 - July 19, at light and flying by day. Moderately common. Larva reported on *Vaccinium*.

4754 *I. subcessaria* Wlk.

Bridgetown, August 12, 1912. In the Canadian National Collection.

4759 *I. anataria* Swett

Coldbrook, Centreville, Petite Riviere, Armdale, Glenville, Stellarton, Baddeck. June 28 - August 10. A common mid-summer species. There is one report of the larva on birch (Canadian Forest Insect Survey).

4771 *I. bitactata* Wlk. Plate XV, Figure 19.

Digby, July 22, 1905; MacNab's Island, July 30, 1906; Stellarton, no date. Rare. Early stages unknown.

(4797a) *I.* (*Dysmigia*) *loricaria julia* Hlst.

Glenville, Cumberland County, July 12, 1949; Baddeck, July 20. Abundant in North Eastern New Brunswick, and seems to penetrate only the northern portions of Nova Scotia. It has been reared from larvae found on poplar in the spring (Lennox, Bruggemann). Female with wings rudimentary but otherwise the species is a normal *Itame.*

Eumacaria Pack.

4774 *E. latiferrugata* Wlk. Plate XVI, Figure 3.

Round Hill, June 23, July 29; Centreville, July 23, 1949; Armdale, June 30, 1945; Debert, June 20, 23, 1952. Scarce. Larva reported on apple, plum and wild cherry (Forbes).

Protitame McD.

4785 *P. virginalis* Hlst.

Annapolis to Halifax, and northward at Bass River, Lakelands, Cumberland County, and Baddeck. June 2 - August 27. Common at light in groves of aspen. Larva on *Populus tremuloides* and *grandidentata* (Rupert).

Hesperumia Pack.

4801 *H. sulphuraria* Pack.

Centreville, Mount Uniacke, Fall River, Armdale, Herring Cove, Shad Bay, Cole Harbour, Glenville and reported also from Cape Breton. July 26 - August 17. Locally common. Farther west and south the food plant is *Ceanothus*, which in Nova Scotia is absent. I suspect that it is feeding on *Gaylussacia.*

Ematurga Lederer

4802 *E. amitaria* Gn.

Generally distributed and common, at least to Terre Noire, Inverness County. May 13 - July 29, flying by day on bogs and blueberry barrens. Supposed to be a general feeder on bog shrubs, including cranberry.

Eufidonia Pack.

4803a *E. notataria convergaria* Wlk.

Digby, South Milford, Auburn, Aldershot, Caledonia, Centreville, Mount Uniacke, Fall River, vicinity of Halifax, Glenville. May 16 - July 23. Locally common. Larva mostly on white pine, perhaps on hemlock and other conifers.

4804 *E. discospilata* Wlk.

White Point Beach to Cape Canso and Baddeck. Generally distributed, and always present on bogs, heaths and barrens. May 31 - August 10, flying by day. Bred from Larvae on *Comptonia* and *Kalmia* in Nova Scotia; *Spiraea* in New Hampshire (Rupert). Otherwise rereported on blueberry, laurel and white birch (Forbes).

Orthofidonia Pack.

4805 *O. tinctaria* Wlk. Plate XV. Figure 20.

This is the small, dark species without yellowish or greenish tints. It is commoner and much less local than *flavivenata*, emerges a week or so later, and has a longer flight period. Nova Scotian specimens agree well with Walker's type in the Canadian National Collection.

Digby, White Point Beach, Lake Kejimukujik, Caledonia, Mount Uniacke, Waverley, vicinity of Halifax. May 16 - July 13. Larvae reared from the egg would eat nothing but *Viburnum cassinoides* and *alnifolium.* Larva pale green, smooth skinned, with broad lateral brown stripe on the head produced posteriorly onto the prothorax. Pink dorsal stripe, broadening on the last four segments, and finally coloring the lateral sides of the last pair of abdominal legs. The pupal cremaster is stout with a convoluted surface, and tapers abruptly to a pointed terminal process. It is without hooks.

4805a *O. flavivenata* Hulst. Plate XV, Figure 21.

This is a distinct species of larger size, bright yellow veining on the primaries, and with a greenish-yellow tint to the maculation generally. It occurs locally early in the spring in mixed deciduous-coniferous forest, and flies for a relatively brief period. Aldershot, Mount Uniacke, Waverley, Armdale, MacNab's Island, Cole Harbour. May 7 - June 10, but usually gone by June 1, Otherwise known only from Quebec (the type), Bar Harbour, Me. (Brower) and Horseheads, N. Y. in April (Rupert). Probably in other collections but confused with *tinctaria.* Early stages unknown.

Hypagyrtis Hbn.

(*Paraphia* Gn.)

4809 *H. subatomaria* Wood

Despite great variability, including melanics, all Nova Scotian examples of this complex, involving the names *subatomaria*, *nubecularia*

Gn. and *triplicipunctaria* Fitch probably belong to but one species, and the name *subatomaria* is chosen only because it seems to have been most commonly applied, possibly in error. The species occurring here is the common northern *Hypagyrtis* with light brown scaling in the outer third of the wing beyond the t.p. line. It occurs commonly from Nova Scotia to Ontario and western New York.

Digby, South Milford and White Point Beach to Glenville, Stellarton and Baddeck. June 23 - August 1, at light. Females rare. Bred at Halifax from larvae found on *Amelanchier* and *Cornus* in the spring. Another larva on alder in the fall hibernated and produced a moth June 11.

4811 *H. piniata* Pack.

Common in coniferous woods from White Point Beach to Glenville, Cape George, and localities in Inverness and Cape Breton Counties. June 19 - August 18. Occasional melanics occur. Larva a general feeder on conifers.

Melanolophia Hulst

4856 *M. canadaria* Gn.

Digby, South Milford, Lake Kejimukujik, Auburn, Centreville, Mount Uniacke, vicinity of Halifax, Baddeck. May 20 - July 7. Not as common as *signataria*. Larvae do well on basswood and maple, and apparently are general feeders on deciduous trees.

4857 *M. signataria* Wlk. Plate XVI, Figure 1.

Walker, Lep. Het. Brit. Mus., pt. 21, p. 350, 1860.
Type locality: Nova Scotia.

Seen from most localities in southern Nova Scotia where spring collecting has been done, and northward at Isle Haute, and in Colchester and Pictou Counties. May 2 - July 6. Often abundant at light in deciduous woods. Feeding habits similar to *canadaria*. Larvae reared *ex ovo* on *Tilia* but moths never emerge.

Protoboarmia McD.

4875a *P. porcelaria indicataria* Wlk.

Generally distributed and usually abundant in coniferous areas. June 8 - August 10. Bred at Caledonia June 7 from a larva collected on balsam fir May 16. A general feeder on conifers.

Glena Hulst

4882 *G. cognataria* Hbn.

Round Hill, Auburn, Coldbrook, Mount Uniacke, Armdale, Peggy's Cove, MacNab's Island, Glenville. June 5 - August 18, at light. Essentially a species of bogs and blueberry barrens. Early stages unknown.

Anavitrinella McD.

4908 *A. pampinaria* Gn. Plate XVI, Figure 4, *erosiata.*

Common and general from Digby and White Point Beach to Baddeck. June 4 - August 31. About fifty per cent are referable to the variety *erosiata* Wlk., with prominent black shading along the t.p. and t.a. lines. Bred from *Rumex* sp. (Rupert).

Anacamptodes McD.

4912 *A. larvaria* Gn.

White Point Beach to Baddeck. Apparently general. June 16 - August 22. Common. Larva on poplar, willow and perhaps other deciduous trees.

4916 *A. ephyraria* Wlk. Plate XVI, Figure 16.

Walker, Lep. Het. Brit. Mus., pt. 21, p. 349, 1860.
Type locality: Nova Scotia.

Under this name and *expressaria* Wlk., also described from Nova Scotia but relegated to the synonymy, there are six specimens from Lieut. Redman's collection in the British Museum. I figure the type of *ephyraria.* No other Nova Scotian specimens are known, and it is unfortunate that the exact locality where the types were collected is unknown, the specimens simply bearing the label "N. Scotia, Redman". The few reports of the food plants of *ephyraria* are rather conflicting, hemlock, wild cherry, birch and elm all being mentioned.

4917 *A. humaria* Gn. Plate XVI, Figure 5.

Mount Uniacke bog, June 15, 17, 1950. A long series of males at light. Auburn, June 5, 1952 (one). Larva a general feeder on deciduous plants (Forbes).

4918 *A. vellivolata* Hulst Plate XVI, Figure 6.

Lequille, June 14, 16, 1949; Waverley, June 1, 1952. Bred from a larva on white spruce in Colchester County (Canadian Forest Insect Survey), but usually considered a pine feeder.

Aethalura McD.

4945 *A. anticaria* Wlk. Plate XV, Figure 18.

Walker, Lep. Het. Brit. Mus., pt. 21, p. 404, 1860.
Type locality: Nova Scotia.

Digby, Lake Kejimukujik and Bridgewater to Stellarton. Probably everywhere. May 2 - June 26, in deciduous woods. Common. Larva on birch.

Ectropis Hbn.

4946 *E. crepuscularia* Schiff.

Digby, Lake Kejimukujik, Annapolis, Mount Uniacke, Halifax, Baddeck, including form *abraxaria* Wlk. (Lep. Het. Brit. Mus., pt. 21, p. 403, 1860. Type locality: Nova Scotia.). April 22 - July 2. A very common spring species. The larva is a very general feeder on both deciduous and coniferous trees.

Nacophora Hulst

4953 *N. quernaria* A. & S.

Digby, Acaciaville, Annapolis, Round Hill, vicinity of Halifax, Baddeck. June 4 - 30. Bred at Annapolis from English oak (*Quercus robur*). Most commonly an oak feeder but has been reported from birch.

Phigalia Duponchel

4958 *P. titea* Cram.

Annapolis, Armdale, MacNab's Island. March 29-April 27, at light. Scarce and sporadic. Missed most seasons because of bad weather during its early flight period. A very general feeder on deciduous trees.

Erannis Hbn.

4964 *E. tiliaria* Harr.

Armdale, MacNab's Island, Glenholme, Stellarton. Probably more widely distributed but missed because of its late emergence. October

21 - November 15. Males at light; the wingless females on tree trunks. Larva on birch, *Amelanchier*, *Prunus* and various other trees in the spring. A general feeder.

Lycia Hbn.

4966 *L. ursaria* Wlk.

Glenholme, Colchester County, May 25, 1952 (W. Harrington); Mount Uniacke, May 20, 1952, at light. Rare. A larva on willow at Dorchester, N. B. The species is a general feeder on deciduous trees.

Biston Leach (*Amphidasis* Tr.)

4968 A. *cognataria* Gn.

White Point Beach and Annapolis to Pictou County. Presumably general. June 6 - August 4. Often abundant at light. Larva a general feeder on deciduous trees, perhaps most commonly seen on willow.

Euchlaena Hbn.

4995.1 *E. muzaria* Wlk.

Many records from Deerfield, Yarmouth County and White Point Beach to Baddeck and Cheticamp. June 23 - August 10. Usually the commonest species of *Euchlaena*. Larvae will eat choke cherry (Rupert).

4996 *E. effecta* Wlk.

Glenville, Cumberland County, July 8, 12 and 29; Baddeck, July 21. Local, and seems to be in the northern counties only. Common in north-eastern New Brunswick. The caterpillar eats wild cherry (Forbes).

4997 *E. johnsonaria* Fitch

Deerfield, Yarmouth County, through the Annapolis Valley where it is common, and at White Point Beach and Petite Riviere. Unlike *effecta*, this species seems confined to southern localities. June 30 - July 26. Larva on *Crataegus* (Rupert) and oak (Forbes). Also reported on ash, birch and elm.

5000 *E. vinulentaria* G. & R.

Acaciaville, Lequille, Auburn, Aylesford, Centreville, Truro, Mount Uniacke bogs, Peggy's Cove, vicinity of Halifax, Stellarton, Baddeck. June 30 - August 12. Essentially a species of bogs and heaths, where it is sometimes very abundant. Early stages unknown, but from its habitat I should guess that it feeds on *Vaccinium* or some other heath plant.

5002 *E. marginaria* Minot

Annapolis, Auburn, Coldbrook, Centreville, Aldershot, Mount Uniacke, Windsor Junction, Armdale. June 4 - July 1. The earliest species of *Euchlaena* to appear in the spring. Locally common in deciduous woods. Larvae reared almost to maturity on *Amelanchier*, then hibernated.

5006 *E. irraria* B. & McD.

Annapolis, South Milford, Round Hill, Stellarton, Glenville, vicinity of Halifax. Often abundant in oak woods, scarcer elsewhere. June 17 - July 16. Nearly all Nova Scotian examples have a diffuse, but broad and contrasting dark shade beyond the postmedial line on both wings. Larva normally on oak, but will eat *Acer saccharum* (Rupert).

Xanthotype Warren

5007 *X. sospeta* Dru.

Truro, June 27, 1937, July 27, 1943 (Payne collection); Glenville, Cumberland County, July 8, 1950, July 12, 1949; also a specimen from Stellarton in the Hills collection that seems to belong here. Scarce. A general feeder on low plants; also on *Cornus*.

5010 *X. urticaria* Swett

Almost everywhere from Barrington Passage to Baddeck. June 23 - August 26. Bred from Larvae on *Nepeta*, *Solidago*, and from a pupa on alder. Also reported on *Cornus stolonifera* (Rupert). Hibernates as a partly grown larva.

Epirrhanthis Hbn. (*Spodolepis* Hlst.)

5012 *E. substriataria* Hulst Plate XVI, Figure 2.

Centreville, May 9, 1950; Waverley, May 20, 1951; Debert, May 10, 1953; Stellarton, no date. Rare. Larva of the European species feeds on poplar.

Campaea Lamarck

5015 *C. perlata* Gn.

White Point Beach and Annapolis to Pictou County, but probably much more general. June 22 - August 31. Common. The somewhat smaller second generation very plentiful at Lake Rossignol, August 24, 1951. Larva reported from a wide variety of deciduous trees. Bred on *Fraxinus americana* (Rupert), and from a larva on wild rose at Halifax.

Gueneria Pack.

5016 *G. basiaria* Wlk.

Lequille, Lake Kejimukujik, Centreville, Mount Uniacke, Waverley, Armdale, Three Brooks, Baddeck. May 21 - July 1, at light and flushed by day. Locally common about patches of ferns in shady places. Larva on *Dryopteris novaboracensis* (Franclemont).

Homochlodes Hulst

5022 *H. fritillaria* Gn.

Through the Annapolis Valley and Mount Uniacke to Halifax, and at Lake Kejimukujik, Petite Riviere, Bridgewater and Isle Haute, off Cape Chignecto. Probably everywhere. May 8 - July 15, at light. Common. Larva on bracken fern, *Pteridium aquilinum* (Rupert).

Lozogramma Stephens

L. R. Rupert, Notes on the Group of Genera Including Lozogramma Stephens and its Allies, Proc. Ent. Soc. Wash., Vol. 51, No. 4, pp. 137-151, 1949.

5025 *L. subaequaria* Wlk.

Caledonia, Greenwood, Mount Uniacke, Isle Haute, Stellarton, Baddeck and near Halifax. May 3 - June 30. Very common in partly shaded marshy spots and wet woods. Larva on bracken fern (Rupert).

Tacparia Wlk.

5023 *T. detersata* Gn.

Digby, Auburn, Aylesford, Centreville, Bridgewater, vicinity of Halifax, Debert. May 10 - June 28. Not generally as common as *subaequaria*. The usual food plant is apparently alder (Rupert).

5024 *T. zalissaria* Wlk. (*atropunctata* Pack.) Plate XVI, Figure 7.

Digby, Annapolis, South Milford, Round Hill, Auburn, Coldbrook, Aldershot, Mount Uniacke, Armdale, MacNab's Island, Peggy's Cove, Port Wallis. May 25 - July 9, at light. Sometimes common, but very local. Larvae reared from the egg on *Myrica gale* refused all other foods offered. Possibly also on *Comptonia*, as the moths were numerous about extensive patches of this plant at Coldbrook.

Cepphis Hbn. (*Priocycla* Gn.)

5028 *C. armataria* H.-S.

South Milford, Armdale, MacNab's Island, Mount Uniacke. Locally common. June 7 - July 21. Bred from Larvae on sweet fern. Otherwise reported on *Ribes*, birch and maple.

5029 *C. decoloraria* Hulst Plate XVI, Figure 9.

Lequille, South Milford, White Point Beach, Armdale and vicinity. June 10 - July 22. Much scarcer than *armataria*. Bred *ex ovo* on blackberry (*Rubus allegheniensis*), which the young larvae seemed to prefer to raspberry, although they would eat both.

Plagodis Hbn.

5030 *P. serinaria* H.-S.

Annapolis, Lake Kejimukujik, Centreville, Mount Uniacke, vicinity of Halifax. May 29 - July 1. Often abundant at light in deciduous or mixed woods. I bred it *ex ovo* on *Betula papyrifera*, and in New York it has been reared on *Tilia* and *Prunus serotina* (Rupert).

5031 *P. kuetzingi* Grt. Plate XVI, Figure 10.

Annapolis Royal, Lequille, Round Hill, Lawrencetown. Apparently in the Annapolis Valley only. June 11 - July 12, and once on August 28. Reared at Annapolis on ash, the only food the larvae would accept.

Although the more familiar name *nigrescaria* Hulst has long been used for this species, *kuetzingi* of Grote appears to have legal priority, and in using it I follow Rupert's recent *Plagodis* revision (Jour. N.Y. Ent. Soc., Vol. LVII, p. 24, 1949).

5038 *P. alcoolaria* Gn.

Annapolis, South Milford, Coldbrook, Centreville, Rockingham, Armdale. June 3 - July 9. Often moderately common in deciduous forest. Bred at Armdale from a larva on white birch. Also reported on oak, beech and basswood.

5040a *P. phlogosaria iris* Rupert Plate XVI, Figure 11.

Rupert, Jour. N. Y. Ent. Soc., Vol. LVII, p. 31, 1949.
Type locality: Armdale, Halifax County, N. S.

This race is single brooded and corresponds to the richly colored spring generation *keutzingaria* Pack. of the eastern United States, but goes a step further in the intensity of coloring.

Quite general and often common in deciduous or mixed forest through southern Nova Scotia from Annapolis and Queens to Halifax County, and northward at Isle Haute and Baddeck. May 29 - July 20. In 1951 I reared *iris ex ovo* on white birch, attempting to force through a second brood, but the adults did not emerge until the following spring.

Anagoga Hbn.

5042 *A. occiduaria* Wlk.

Acaciaville, South Milford, Coldbrook, Mount Uniacke, vicinity of Halifax, Isle Haute, Baddeck. May 31 - July 29. A common spring and early summer species of wooded areas. Bred from *Viburnum cassinoides*, but probably a rather general feeder.

Hyperetis Gn.

5043,1 *H. alienaria* H.-S.

Widely distributed. Records from Lake Kejimukujik and South Milford north to Cheticamp and Ingonish. May 29 - July 21. They include a high percentage of form *exsinuaria* Gn. Beech, hawthorn, wild cherry and ash have been reported as food plants.

5043,2 *H. nepiasaria* Wlk. Plate XVI, Figure 8.

Walker, Lep. Het. Brit. Mus., pt. 22, p. 146, 1860.
Type locality: Nova Scotia.

Widely distributed and often very common where found. Barrington Passage, Shelburne and White Point Beach to Glenville, Stellarton and Baddeck. May 30 - July 30, mostly at light. Essentially a species of acid soil conditions, such as bogs, heaths and scrubby woodland in granitic areas. Bred a number of times from larvae on *Kalmia angustifolia.*

Nematocampa Gn.

5044 *N. filamentaria* Gn.

Digby, White Point Beach, Centreville, Armdale, Glenville, Stellarton, French Mountain, Inverness County, July 22 - August 31. Sometimes common. Larva on *Amelanchier* and *Crataegus* (Rupert), and reported on various other deciduous trees by the Canadian Forest Insect Survey. Commonly feeds on herbaceous plants according to Dr. Forbes.

Metarranthis Warren

5046 *M. hypochraria* H.-S.

The name *hypochraria* might really belong to 5046,2, but this is the species to which it has been applied most commonly for many years. Until the matter is finally settled, I am using the names as applied in Mr. Laurence R. Rupert's *Metarranthis* revision of 1943 (Jour. N.Y. Ent. Soc., Vol. LI, pp. 133-159).

Records from most localities, including Cape Breton. June 1 - July 12. Often plentiful. The larvae do very well on choke cherry (Rupert).

5046,1 *M. lateritiaria* Gn. Plate XVI, Figure 13.

Annapolis Royal and Lequille, June 16 - 29. Scarce. Early stages unknown.

5046,2 *M. broweri* Rupert Plate XVI, Figure 14.

Perhaps the same as both *hypochraria* H.- S. and *indeclinata* Wlk.

Acaciaville, Annapolis, South Milford, Centreville, Mount Uniacke, and widely distributed but scarce in the neighbourhood of Halifax. June 2 - July 7. Much less common than *hypochraria.* Reared from the egg on *Vaccinium* (McDunnough) and *Prunus virginiana* (Ferguson), the latter producing larger specimens. Nova Scotian examples belong to a small, dark northern race otherwise seen only from the vicinity of Montreal.

5050 *M. duaria* Gn.

Barrington Passage and Annapolis to Stellarton, Pictou County, but probably also elsewhere in the northern counties. May 16 - July 15. The commonest *Metarranthis.* Over fifty percent have the deep red-brown shade before the t.p. line, and are hence referable to the variety *septentrionaria* B. & McD. (which might fall to *panisaria* Wlk.).
Larvae reared on blueberry, but they perhaps do better on basswood and choke cherry.

5050,1 *M. franclemonti* Rupert Plate XVI, Figure 15.

Perhaps the same as *amyrisaria* Wlk.

South Milford, Auburn, Centreville, Bridgewater, Mount Uniacke, Halifax and vicinity .May 26 - July 1. Locally common in the same habitat as *duaria*, but never quite as plentiful as that species. Bred *ex ovo* on blueberry and *Tilia glabra*, doing quite well on both. Also reared on choke cherry (Rupert).

5052 *M. obfirmaria* Hbn.

Greenwood, Mount Uniacke, Armdale, Spryfield, Halifax, Dartmouth, Baddeck. May 31 - July 10. In this region at least, *obfirmaria* is a thoroughly specialized bog and heath dweller, having even assumed the diurnal habits characteristic of so many bog species. Unlike all the other species of the genus, I have never taken this one at light, but have always flushed and netted it by day. Presumably the larva feeds normally on *Vaccinium* or some other heath plant, but Rupert successfully reared it on choke cherry.

Metanema Gn.

5054 *M. inatomaria* Gn.

Lawrencetown, Armdale, MacNab's Island, Mason's Point, Halifax County, Stellarton, Three Brooks, Baddeck. July 8 - August 2. Locally common at light in dry woodland. Larva on aspen.

5055 *M. determinata* Wlk.

Widely distributed but not as common as *inatomaria*. White Point Beach and Digby to Glenville, Stellarton and Baddeck. June 4 - August 17. Bred from a larva on willow at Mount Uniacke. The pupa is peculiar in being decidedly flattened dorso-ventrally—a character evidently shared with *inatomaria*.

Selenia Hbn.

5057 *S. alciphearia* Wlk.

Annapolis, Centreville, Mount Uniacke, Waverley, Armdale, MacNab's Island. May 7 - June 13. Rather common but local, and easily overlooked because of its early emergence. Broods reared from two females fed freely on both *Betula papyrifera* and *Acer rubrum*.

5058 *S. kentaria* G. &. R.

Annapolis, Lake Kejimukujik, Caledonia, Coldbrook, Bridgewater, Armdale, Waverley, MacNab's Island, Windsor Junction, Halifax

County. May 9 - June 28. Much scarcer than *alciphearia* but perhaps not so local. Larva reported on birch, maple, basswood and beech. As with the other *Selenia*, there is no evidence of a second generation in this area.

Ennomos Tr.

5059 *E. subsignarius* Hbn.

Halifax, August 22, 1923; MacNab's Island, August 9, 1906. Rare. Bred from *Acer saccharum* (Rupert), and reported on many other deciduous trees.

(5170) *E. magnarius* Gn. (*Deuteronomos magnarius* Gn.)

From Annapolis Royal through the Annapolis Valley to Halifax County and northward at Stellarton. Probably throughout. August 12 - October 15. Often abundant at light. A general feeder on deciduous trees.

Pero H.-S.

5072 *P. honestarius* Wlk.

White Point Beach and Digby to Baddeck. Apparently common throughout. June 4 - July 21. Larva on *Prunus virginiana* (Rupert).

5080 *P. morrisonarius* Hy. Edw.

Similarly widespread, and often commoner than the preceding. May 27 - July 21. Quite variable, some examples coming very close to *marmoratus*, yet by genitalia seem to belong here. Larva on hemlock and probably other conifers.

Cingilia Wlk.

5109 *C. canosaria* Wlk. (*Nepytia canosaria* Wlk.). Plate XVI, Figure 12.

Walker, Lep. Het. Brit. Mus., pt. 26, p. 1674, 1862.
Type locality: Nova Scotia.

Digby, Lake Rossignol; Kentville, Mount Uniacke, and everywhere in Halifax County. Probably throughout. August 11 - October 10. A general feeder on conifers.

(5152) *C. catenaria* Dru.

White Point Beach, Annapolis, Bridgetown, Aylesford, Wellington, Armdale, MacNab's Island, Peggy's Cove. September 5 - October 11, at light and flying by day. The larvae show a distinct preference for *Myrica*, both bayberry and sweet gale, hence the species is frequently common in bogs and sea-shore localities. Bred once from willow.

Many, or perhaps most of the specimens are of the dark, sooty, gray-brown variety *rubiferaria* Swett.

Caripeta Wlk.

5125 *C. divisata* Wlk.

Walker, Lep. Het. Brit. Mus., pt. 26, p. 1525, 1862.
Type locality: Nova Scotia.

White Point Beach to Baddeck and Cheticamp. Present everywhere in coniferous areas. June 24 - August 5. Larva on conifers, especially hemlock, spruce and balsam fir.

Two different melanic aberrations occur; one of these is *nigraria* Forbes and another, rarer and apparently unnamed, has the primaries uniformly black except for contrastingly white t.p. and t.a. lines and discal spot.

5126 *C. piniata* Pack.

Annapolis, South Milford, Aldershot, Mount Uniacke, Mason's Point, Halifax County. June 4 - July 9, at light. Occasionally common, but local. Bred from larvae on white pine.

5128 *C. angustiorata* Wlk. Plate XVI, Figure 17.

Walker, Lep. Het. Brit. Mus., pt. 26, p. 1524, 1862.
Type locality: Nova Scotia.

White Point Beach, Lake Rossignol, Petite Riviere, West Northfield, Lunenburg County, Centreville, Kentville, vicinity of Halifax, Stellarton. July 1 - August 23. Usually commoner than *piniata*. Larva on white pine.

Lambdina Capps

5143 *L. athasaria* Wlk.

Acaciaville, Digby, Annapolis, Lake Kejimukujik, Bridgewater, Rockingham, Halifax County. May 28 - June 22, at light in hemlock woods. Locally common. Reported on *Quercus alba* in western New York (Rupert) but in the Nova Scotian localities there is often no oak present, although there is usually some beech. If it is a conifer feeder the food is certainly hemlock.

(5146) *L. fiscellaria* Gn.

Abundant from Queens and Annapolis north to Cumberland and Pictou counties. Probably everywhere. August 24 - October 10. Larva commonly feeding on spruce, fir and hemlock, and bred once from a larva on red oak at Armdale.

Besma Capps

5144 *B.* *endropiaria* G. & R.

Digby, South Milford, Annapolis, vicinity of Halifax, Baddeck, Cheticamp. June 10 - July 2. Moderately common. Reared on *Acer saccharum* (Rupert).

5145 *B.* *quercivoraria* Gn.

White Point Beach, South Milford, Annapolis, vicinity of Halifax, Baddeck, French Mountain, Inverness County. June 10 - July 25, and once on August 20. Moderately common in beech and oak woods. Reared on *Quercus alba* and *Fagus grandifolia* (Rupert).

Sicya Gn.

5161 *S.* *macularia* Harr.

Most localities from White Point Beach to Cumberland and Pictou counties, and at Baddeck. July 20 - August 28, at light. Locally common. The larva has been reported on *Spiraea*, *Ceanothus* and ash.

Apicia Gn.

5184 *A.* *confusaria* Hbn.

Digby, Annapolis Royal, Lawrencetown, Annapolis County. July 6-15. Often very common where found. Larva reported on *Solidago* and other Compositae.

Tetracis Gn.

5197 *T.* *crocallata* Gn.

Generally distributed and very common all through southern Nova Scotia to Northumberland Strait. No Cape Breton records but is certainly to be expected there. May 24 - July 19. Bred from a larva on alder, and reported on *Rhus typhina*.

Nova Scotian material belongs to a northern race that averages rather small, lacks the brown line on the secondaries and is uniformly dusted with brown scales. According to Dr. Forbes this is not *aspilata* Gn.

5198 *T.* *cachexiata* Gn. (*T.* *lorata* Grt.)

Digby, South Milford, White Point Beach, Petite Riviere, vicinity of Halifax, Isle Haute. June 11 - July 4. Often very plentiful. A very general feeder on trees and shrubs. I bred it from larvae on *Comptonia* and *Kalmia angustifolia*.

Abbottana Hulst

5199 *A. clemataria* A. & S.

White Point Beach, Caledonia, South Milford, Centreville, Halifax and vicinity. May 15 - June 28. Often abundant at light in deciduous woods. A general feeder on deciduous trees. Bred from blueberry (McDunnough).

Antepione Pack.

5200 *A. thisoaria* Gn.

A well defined northern bog and heath dwelling race, somewhat smaller than normal and including specimens varying from solid brown to yellow all within the one brood.

Annapolis, South Milford, Round Hill, Auburn, Coldbrook, Mount Uniacke, Armdale, Purcell's Cove, Peggy's Cove and other Halifax County localities, Debert, Baddeck. June 5 - July 9, at light. Single brooded. Often abundant on bogs, and on pine barrens of the Annapolis Valley. Very rare elsewhere. Seemingly a rather general feeder on deciduous trees farther south; probably more specialized here.

Prochoerodes Wlk.

5211 *P. transversata* Dru.

Annapolis, Lake Rossignol, White Point Beach, Mount Uniacke, Wellington, Armdale, MacNab's Island, Peggy's Cove, Truro, Stellarton. Probably everywhere. August 14 - October 28. Abundant at light and sometimes bait. A very general feeder. Bred from choke cherry at Annapolis.

EPIPLEMIDAE

Callizzia Pack.

5223 *C. amorata* Pack.

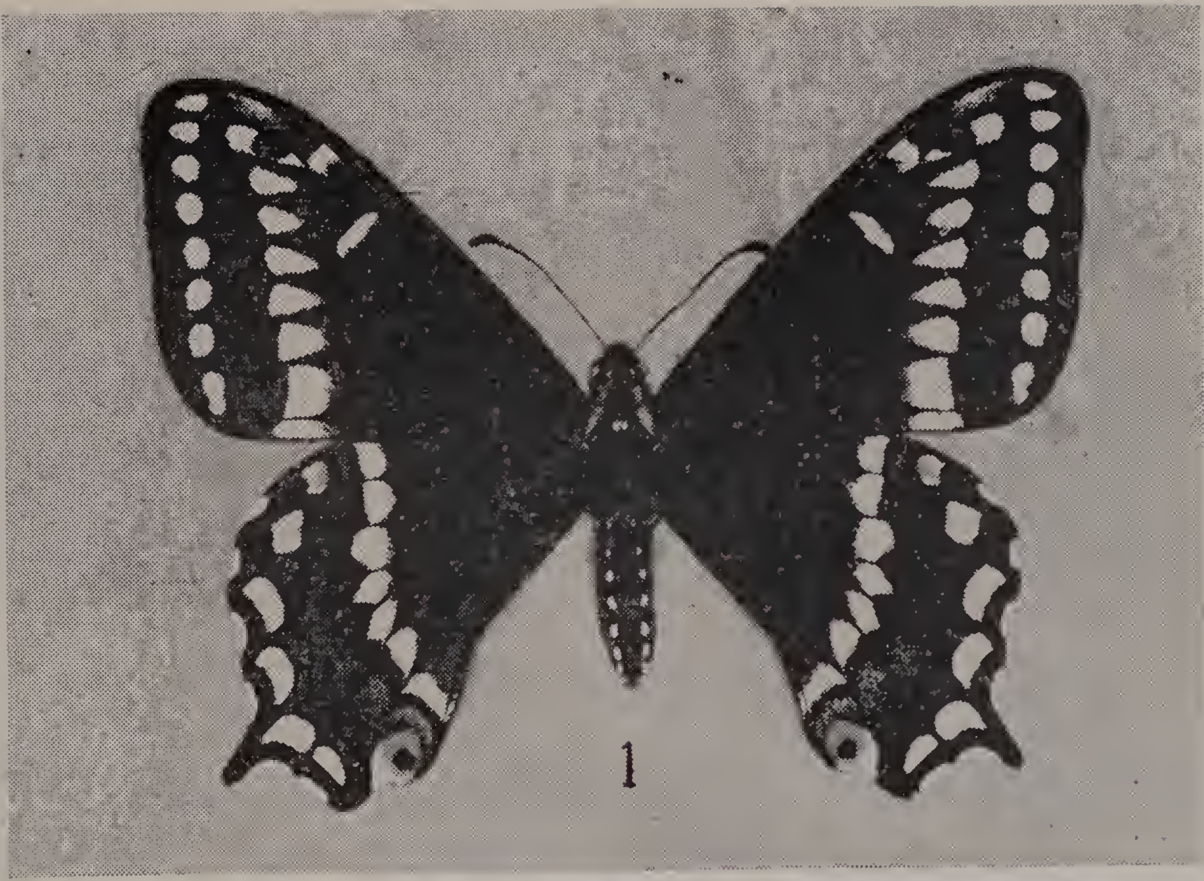
Digby, Acaciaville, Lequille, Mount Uniacke, Waverley, Armdale, Bass River, Baddeck. Widely distributed but occurs sparingly. June 15 - August 5, at light. Little is known about the early stages, but Forbes records the larva from *Lonicera dioica*.

ILLUSTRATIONS OF RARE AND TYPICAL LEPIDOPTERA FROM NOVA SCOTIA

All photographs by the author, except those of types in the Canadian National Collection, which were received through the courtesy of the Systematic Unit, Division of Entomology, Ottawa. The photograph of the type of *Anacamptodes ephyraria* Wlk. was kindly furnished by Mr. D. S. Fletcher, Dept. of Entomology, British Museum (Natural History).

PLATE I

1. Papilio brevicauda bretonensis McD. ♂. Holotype.
2. Speyeria cybele novascotiae McD. ♂. Holotype, underside.
3. Boloria titania grandis B. & McD. ♂. Parrsboro, August 12, 1949.
4. The same, underside.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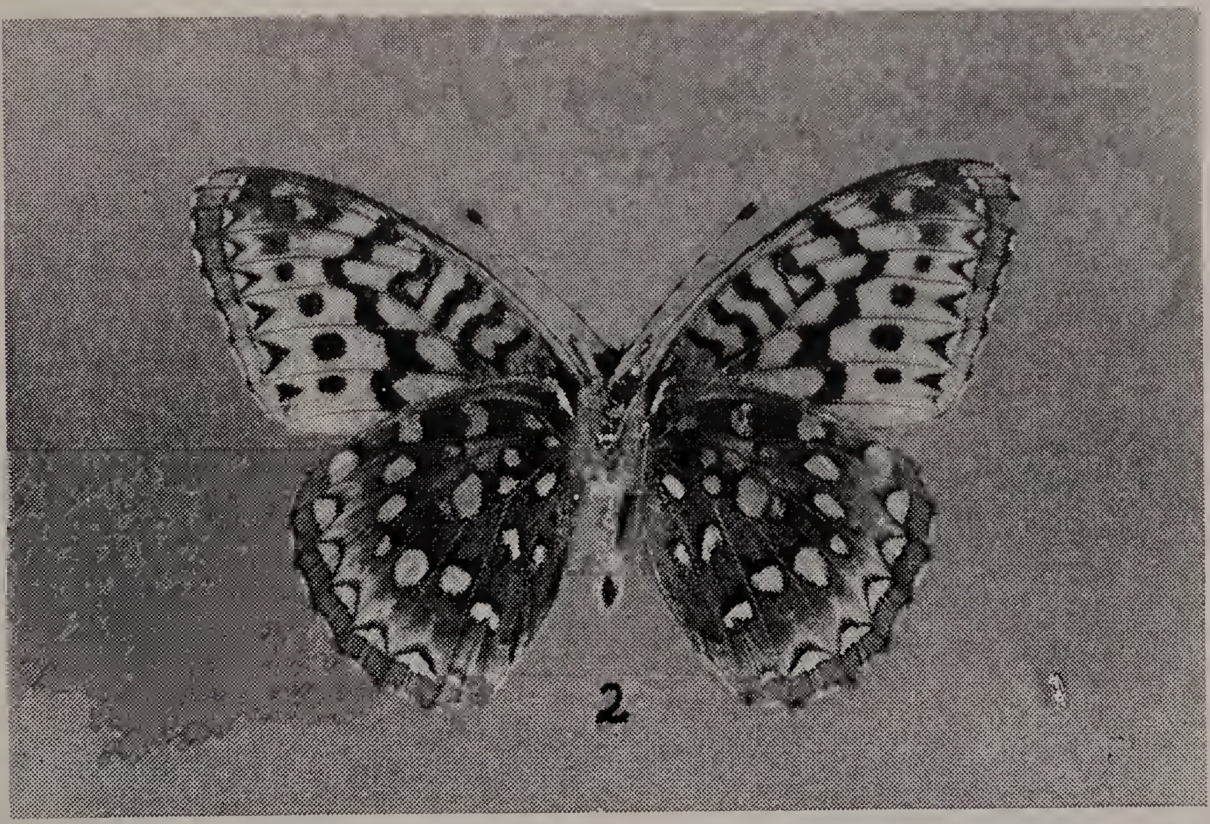
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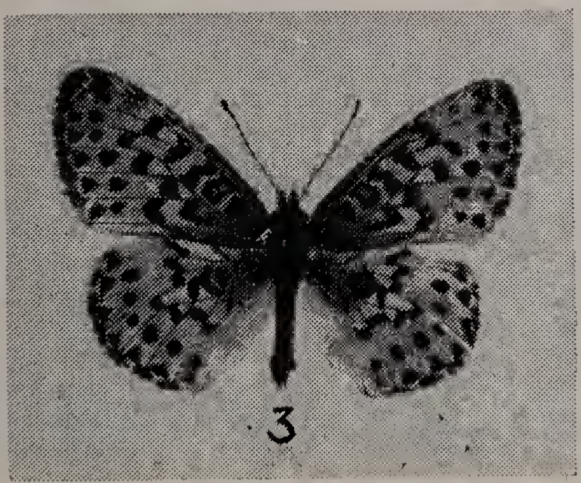
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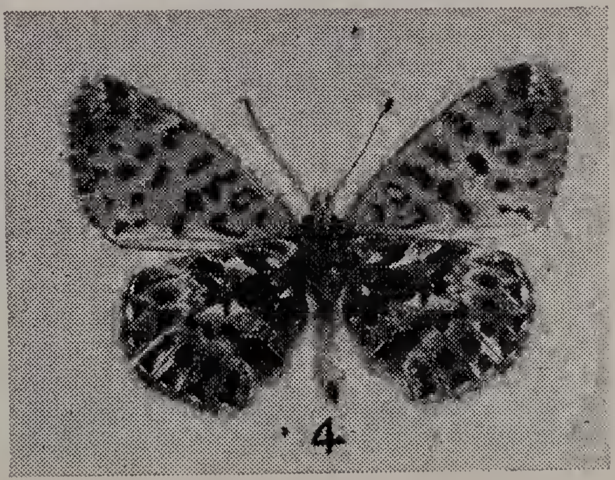
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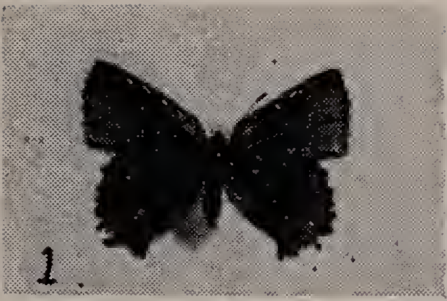
PLATE II

1. Incisalia henrici G. & R. ♀. Armdale, June 6, 1943.
2. The same, underside.
3. Erora laeta Edw. ♀. Armdale, May 14, 1944.
4. The same, underside.
5 Lycaena epixanthe phaedra Hall ♂. Herring Cove, July 21, 1950.
6. ,, ,, ,, ,, ♂. Terre Noire, July 6, 1949.
7. Feniseca tarquinius nova-scotiae McD. ♂. Holotype.
8. Lycaeides argyrognomon empetri Frmn. ♂. Holotype.
9. The same, underside.
10. Glaucopsyche lygdamus mildredae Cherm. ♂. Holotype.
11. The same, underside.
12. Hesperia laurentina Lyman ♂. Parrsboro, August 12, 1949.
13. The same, underside.
14. Amblyscirtes hegon Scud. ♂. Annapolis Royal, June 12, 1949.
15. ,, ,, ,, ♂. underside. Fall River, June 12, '06.
16. Sphinx luscitiosa Clem. ♀. Armdale, July 19, 1945.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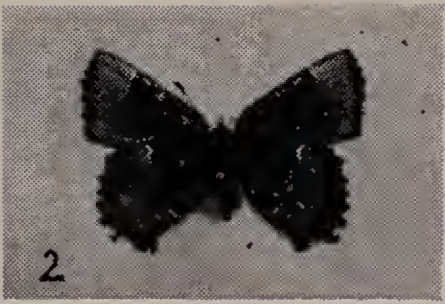
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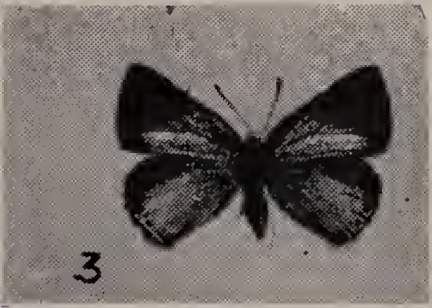
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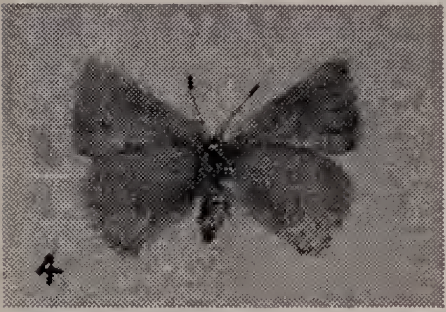
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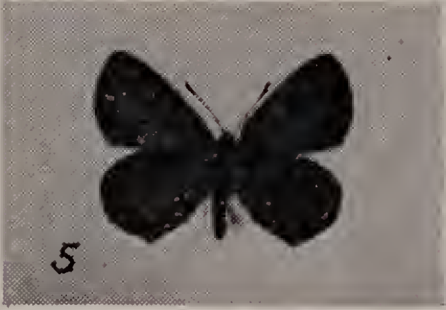
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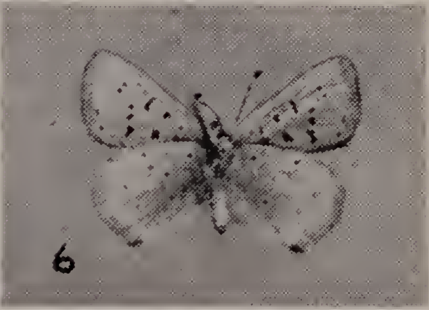
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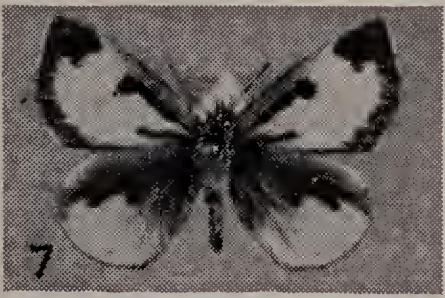
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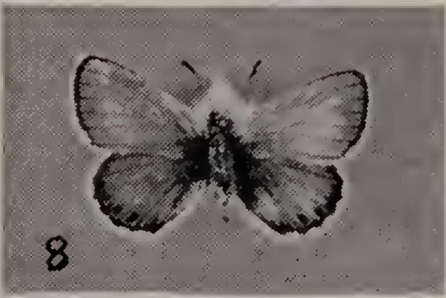
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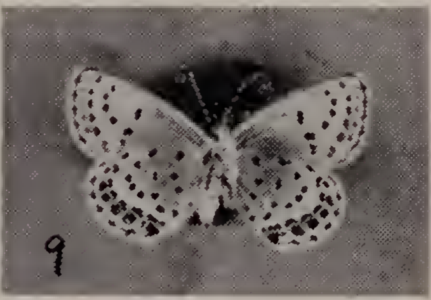
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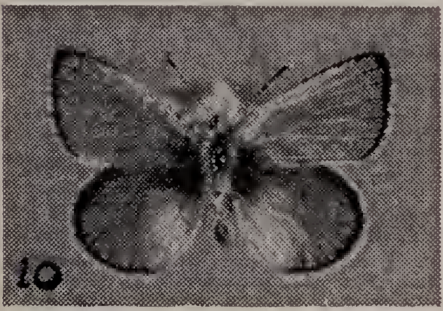
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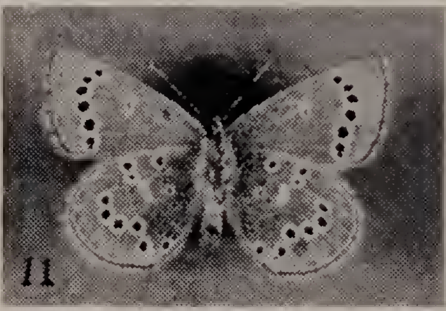
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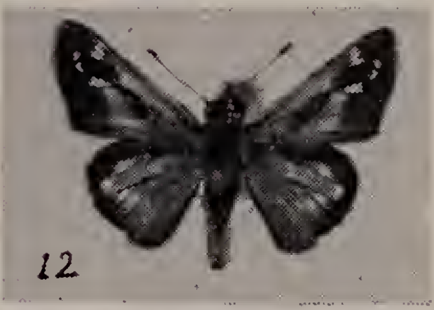
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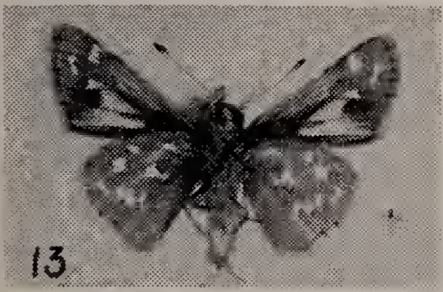
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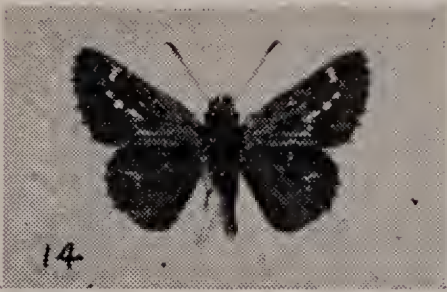
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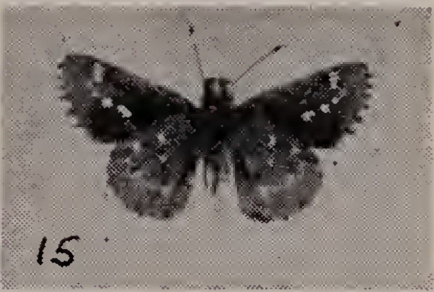
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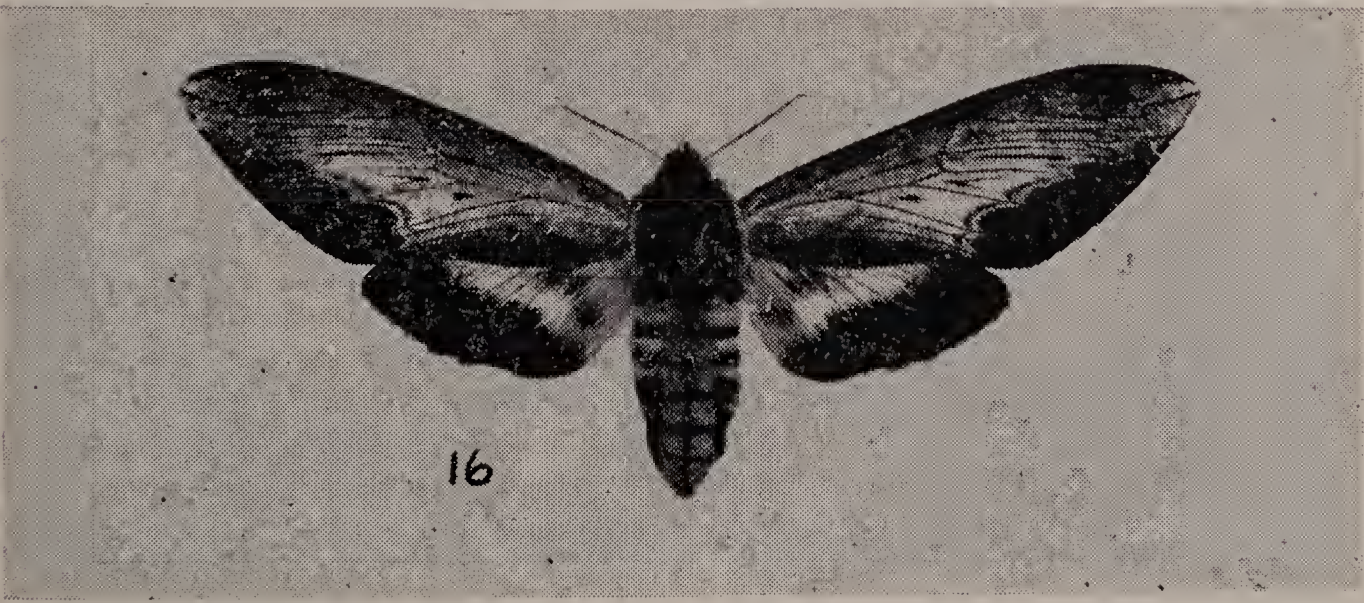
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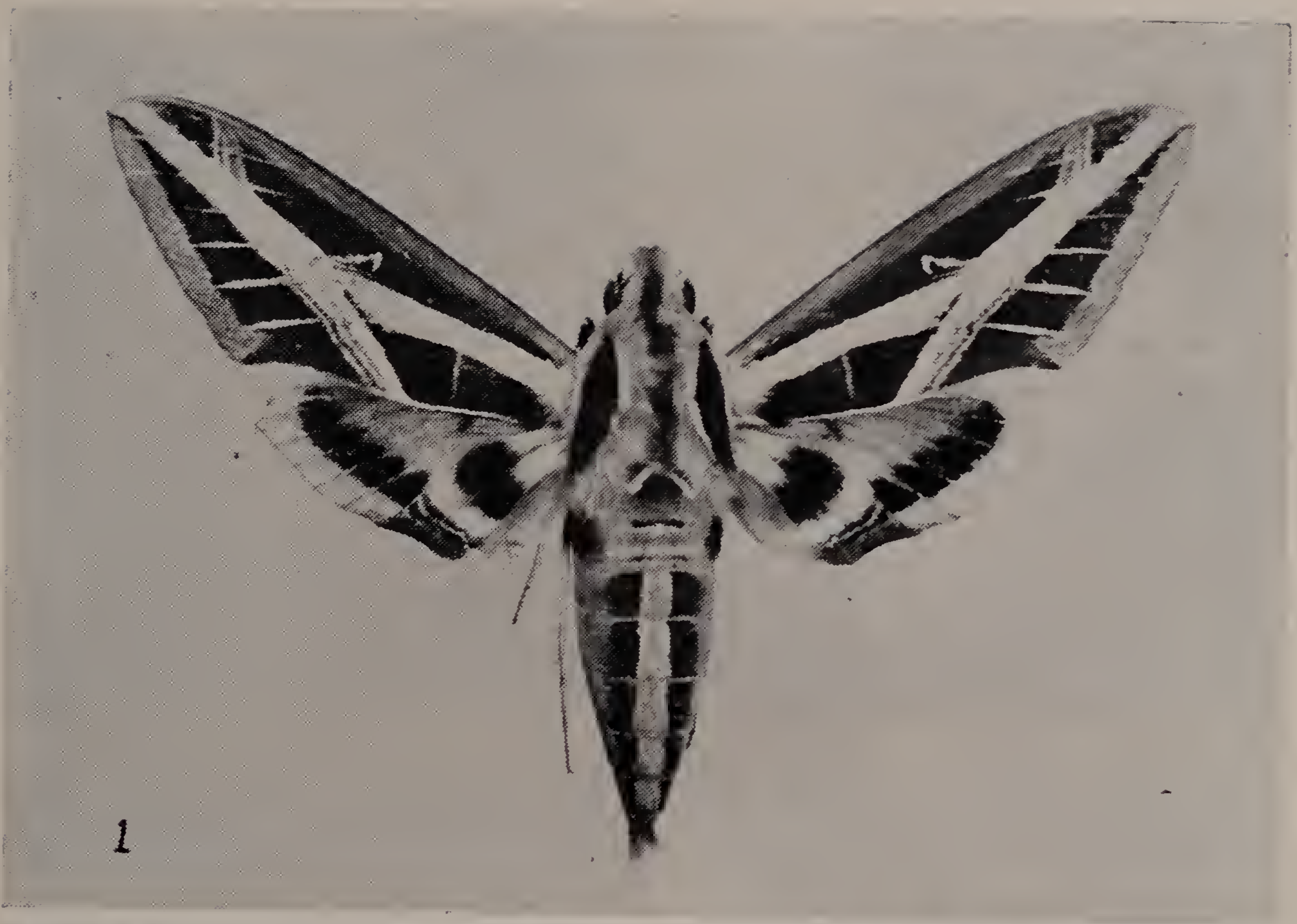
PLATE III

1. Pholus fasciatus Sulz. ♂. MacNab's Island, August 20, 1907.
2. Celama triquetrana Fitch ♂. Acaciaville, June 15, 1949.
3. Sarbena minuscula Zell. ♂. Lequille, June 23, 1950.
4. Eubaphe lamae Frmn., bred ♂. Bog on the Prospect Road, Halifax County.
5. Hemaris gracilis G. & R. ♂. Southampton, August 5, 1949.
6. Apantesis doris minea Sloss. ♂. Lequille, June 23, 1946.
7. ,, celia Saund. Bred ♂. Aldershot, Kings County.
8. Phragmatobia assimilans Wlk. ♂. Mount Uniacke, May 19, 1949.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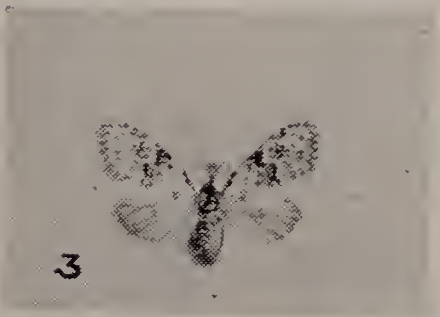
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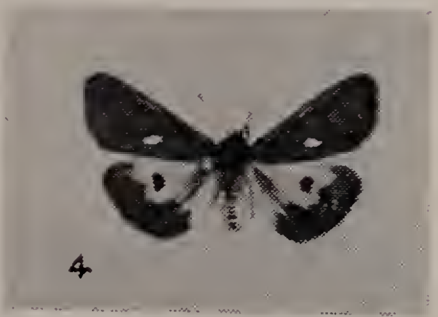
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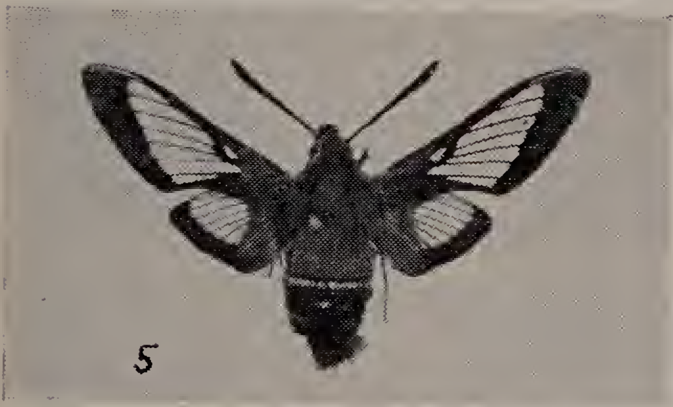
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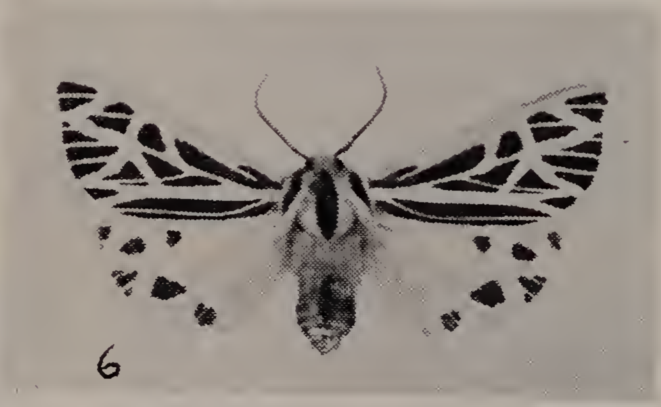
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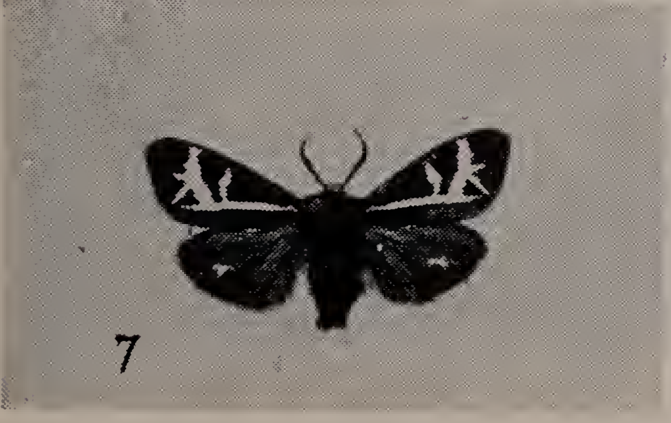
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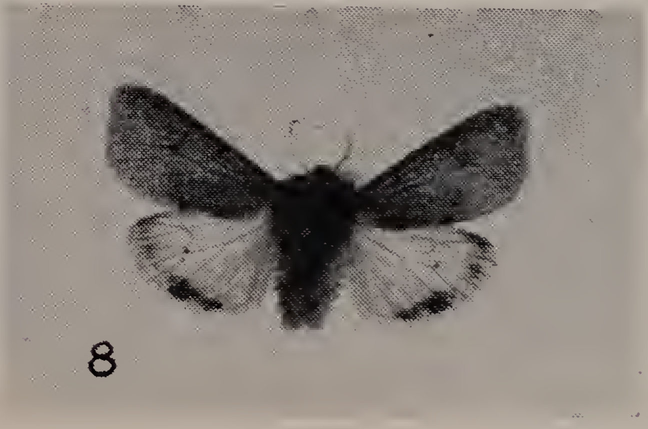
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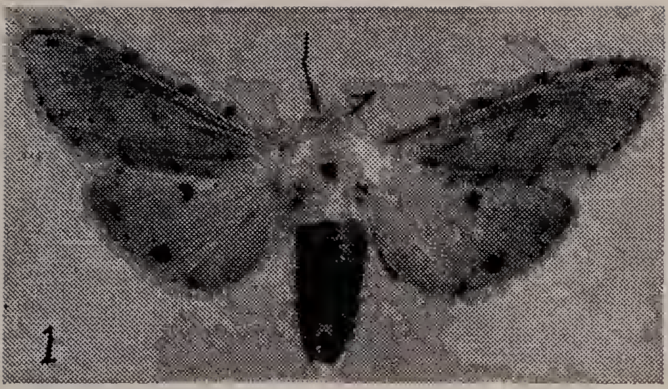
PLATE IV

1. Estigmene acrea Dru. ♂. Dark sooty form. Annapolis Royal, June 30, 1946.
2. ,, prima Sloss. ♂. Armdale, May 30, 1948.
3. Colocasia flavicornis Sm. ♂. Lake Kejimukujik, May 29, 1950.
4. Panthea pallescens McD. ♂. Holotype.
5. Acronicta funeralis G. & R. Wolfville, bred from larva on willow.
6. ,, laetifica Sm. ♂. Lequille, June 27, 1946.
7. ,, furcifera Gn. ♀. Digby, June 25, 1907.
8. ,, lanceolaria Grt. Granville Ferry, bred from larva on alder.
9. ,, lobeliae Gn. ♂. Lequille, July 28, 1946.
10. ,, subochrea Grt. ♀. Lequille, July 29, 1946.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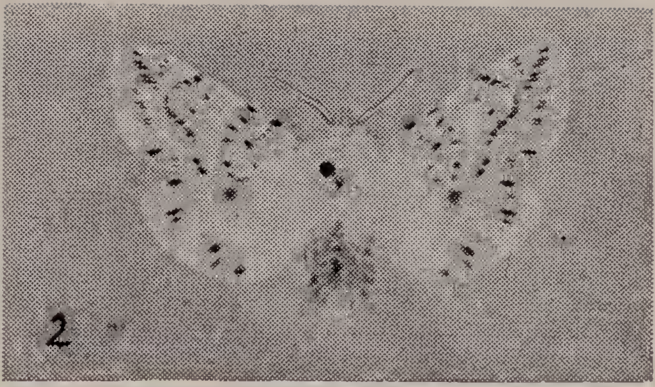
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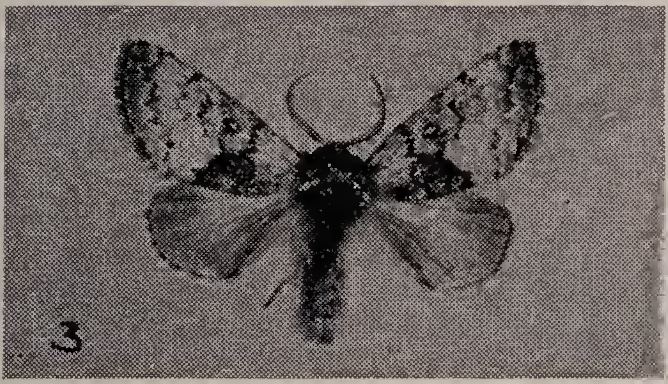
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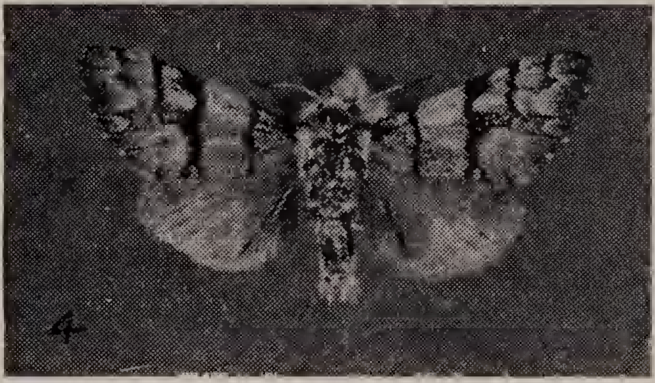
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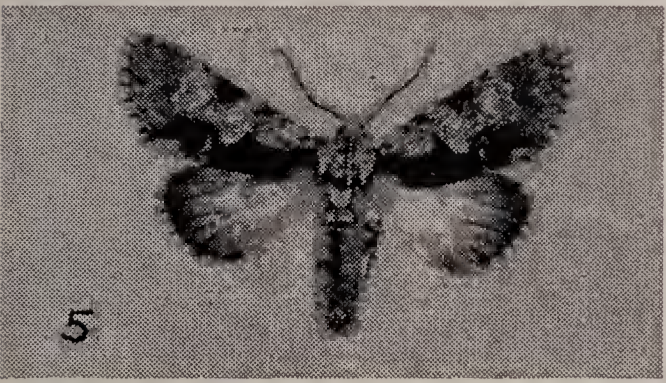
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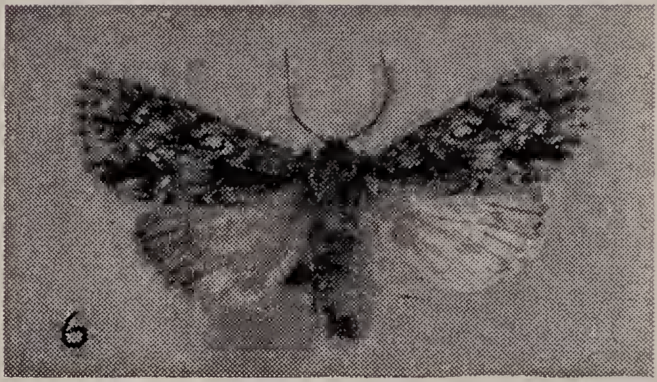
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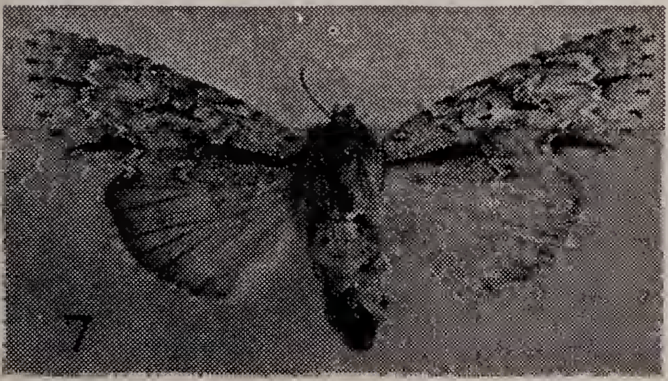
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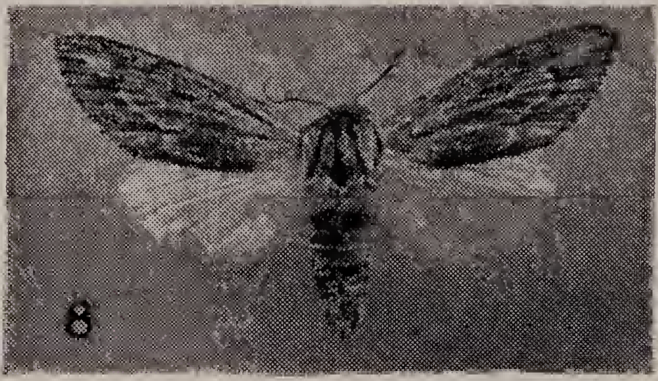
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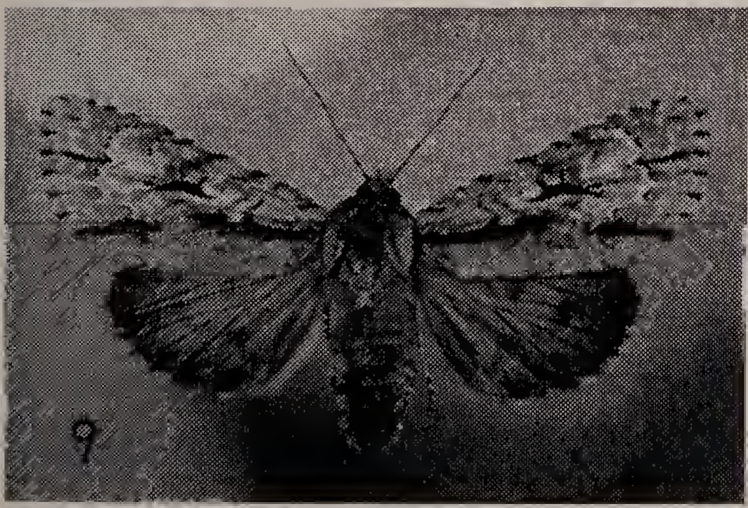
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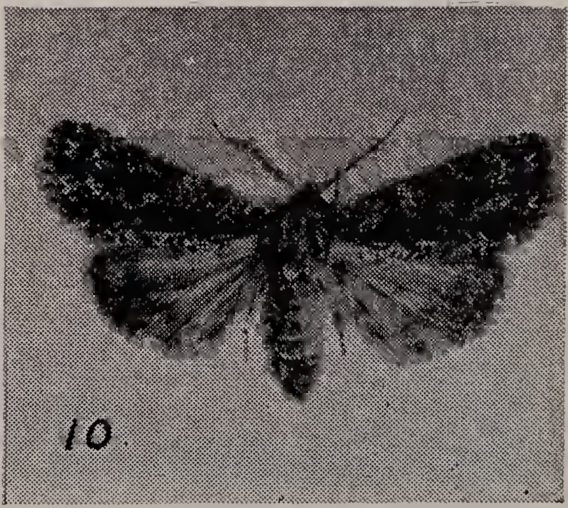
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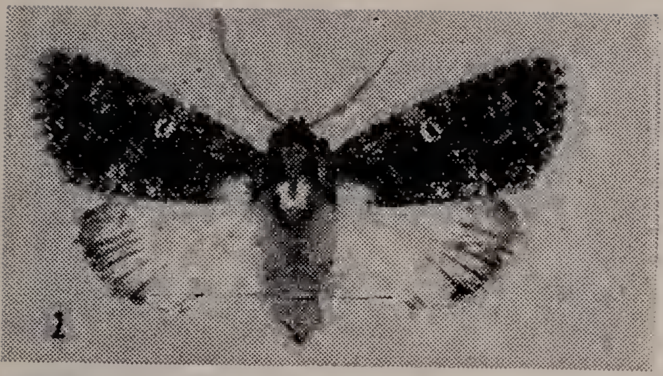
PLATE V

1. Acronicta afflicta Grt. ♀. Lequille, June 26, 1946.
2. ,, hamamelis Gn. ♂. Annapolis Royal, bred from larva on oak.
3. ,, inclara Sm. ♀. Lequille, July 14, 1946.
4. Euxoa detersa Wlk. ♂. Topotypical. Peggy's Cove, September 20, 1952.
5. ,, perpolita Morr. ♂. Aylesford, September 2, 1951.
6. ,, mimallonis Grt. ♂. Shad Bay, July 29, 1952.
7. ,, scholastica McD. ♂. Armdale, July 31, 1950.
8. ,, ontario vestitura Sm. ♂. Armdale, August 9, 1948.
9. ,, divergens Wlk. ♂. Topotypical. Auburn, June 30, 1951.
10. ,, tristicula Morr. ♀. Annapolis Royal, June 27, 1930.
11. Agrotis mollis Wlk. ♀. Lequille, July 25, 1949.
12. ,, gladiaria Morr. ♂. Armdale, September 16, 1947.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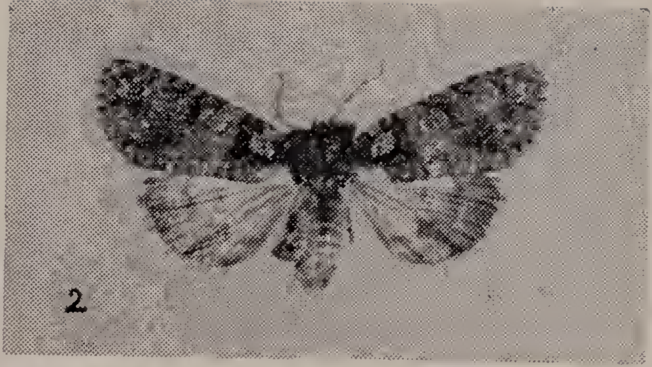
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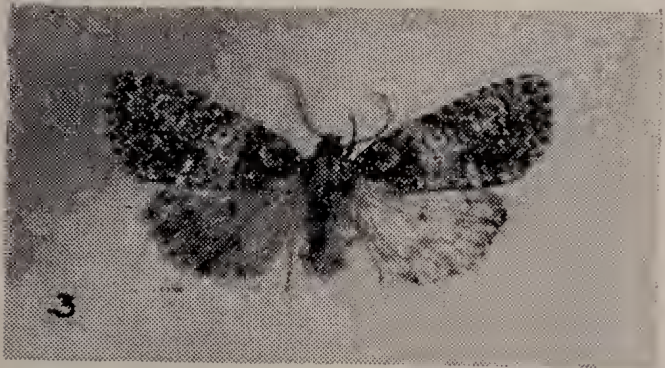
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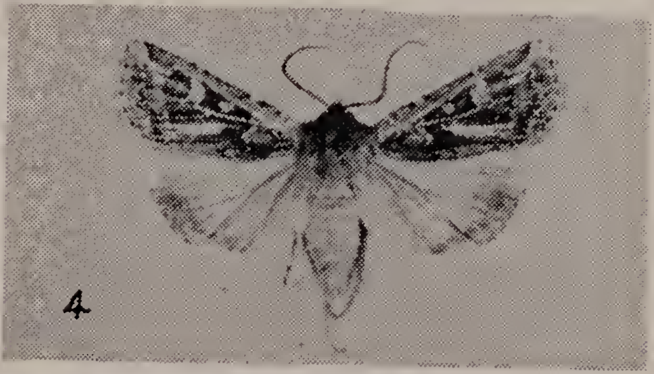
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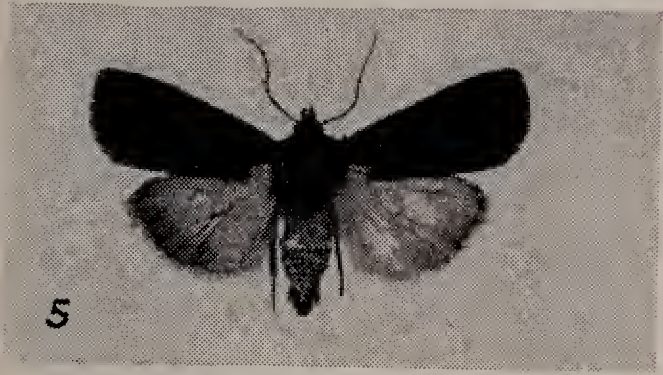
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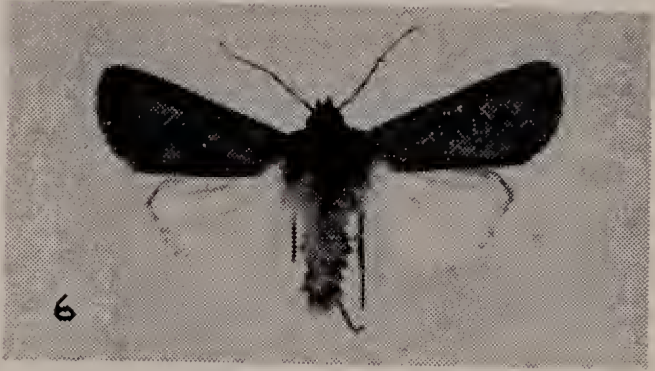
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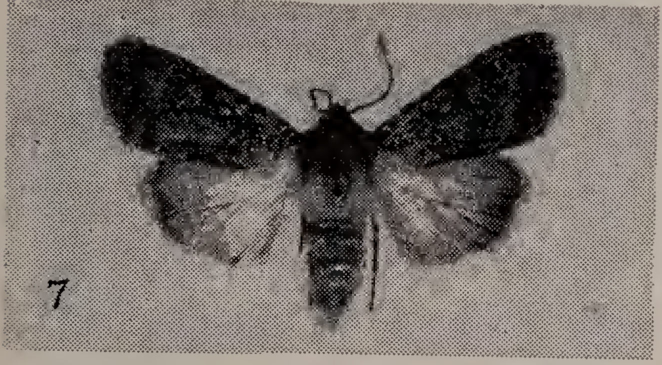
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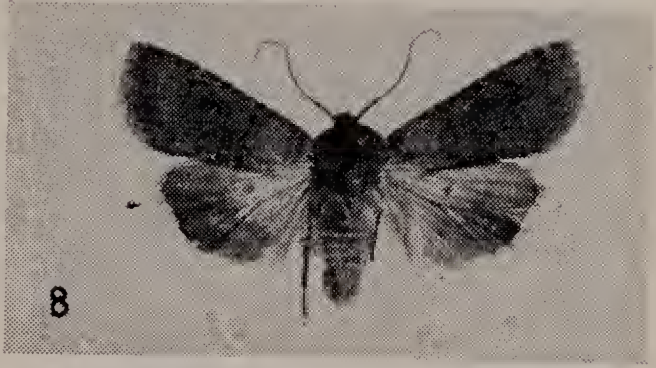
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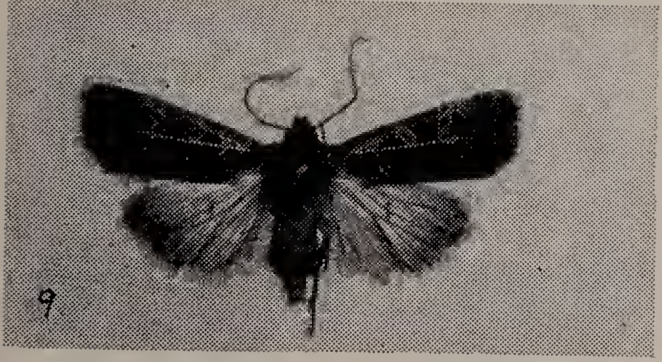
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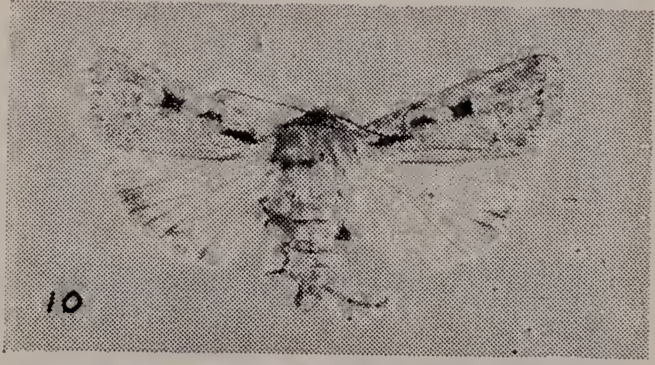
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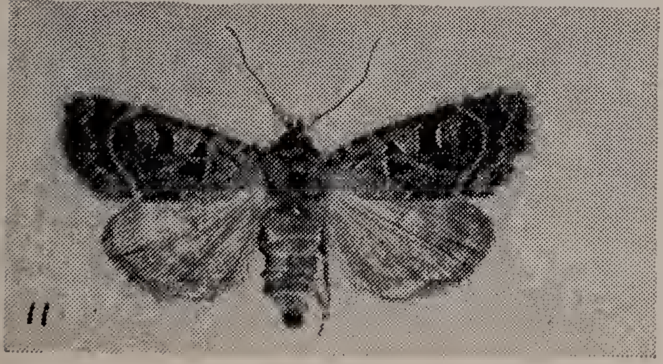
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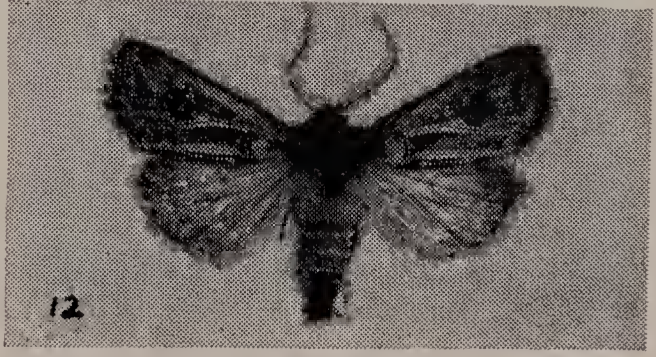
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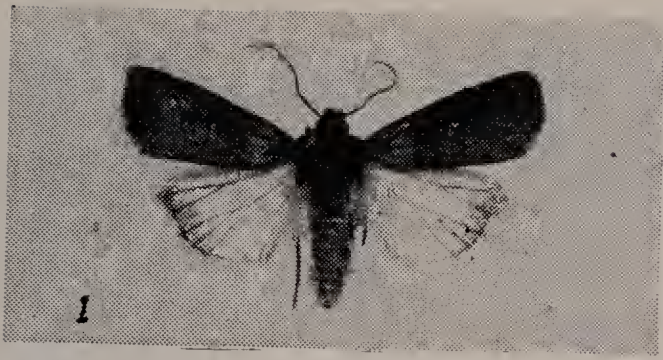
PLATE VI

1. Euxoa albipennis Grt. ♂. Auburn, September 1, 1951.
2. Feltia ducens Wlk. ♂. Lequille, August 25, 1946.
3. Metalepsis fishi Grt. ♂. Aldershot, May 11, 1950.
4. Caradrina quadrangula Zett. ♀. Shad Bay, July 29, 1952.
5. Graphiphora oblata Morr. ♂. Mount Uniacke, July 9, 1947.
6. Diarsia pseudorosaria freemani Hdwk. ♂. Digby, July 1, 1907.
7. Anomogyna perquiritata Morr. ♂. Halifax watershed area, August 10, 1950.
8. ,, imperita Hbn. ♂. Mount Uniacke, August 12, 1950.
9. Aplectoides condita Gn. ♂. Mount Uniacke, June 15, 1950.
10. Euagrotis forbesi Franclemont ♂. Debert, July 15, 1952.
11. Scotogramma trifolii albifusa Wlk. ♀. Topotypical. Armdale, August 15, 1950.
12. Mamestra curialis Sm. ♀. MacNab's Island, June 28, 1906.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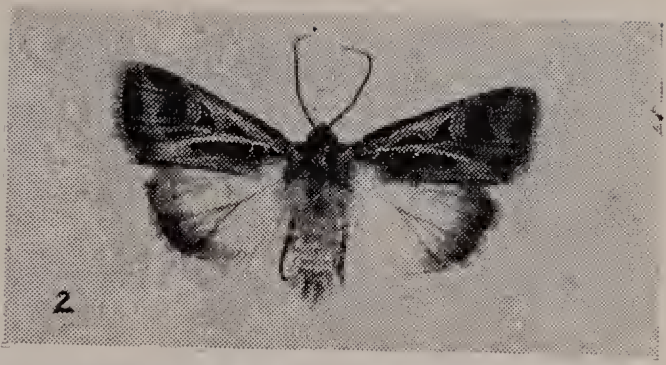
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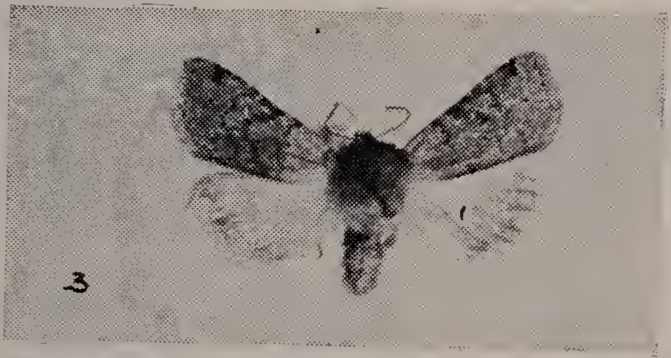
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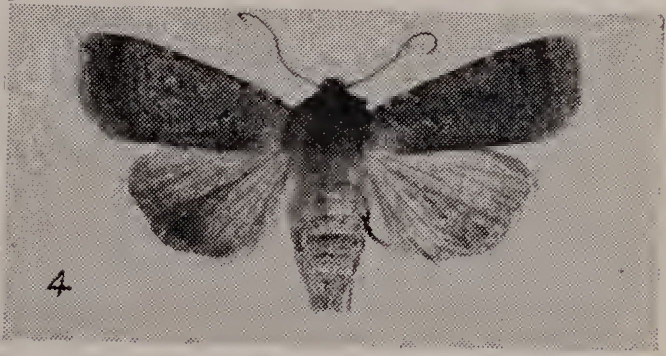
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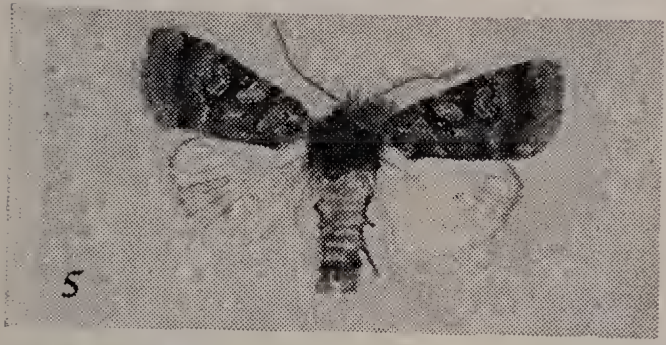
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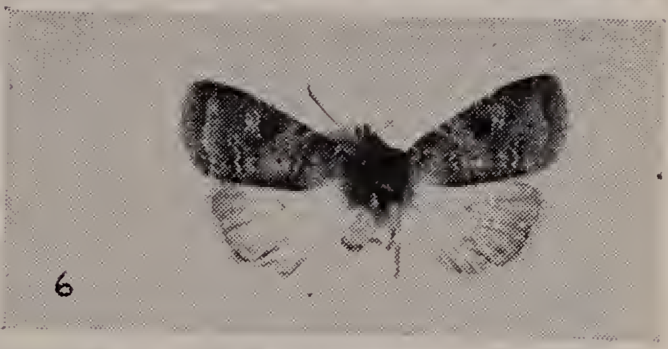
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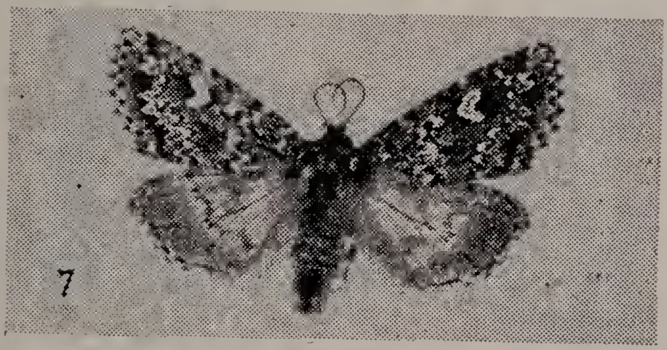
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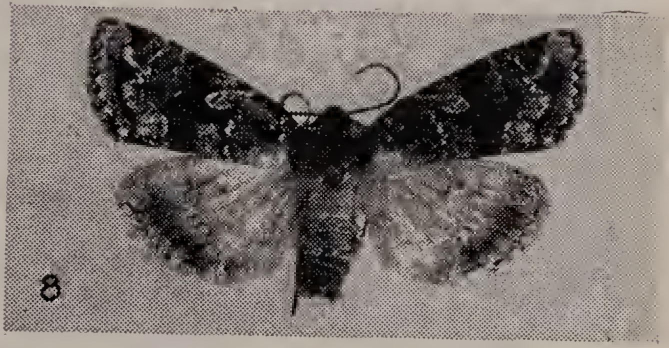
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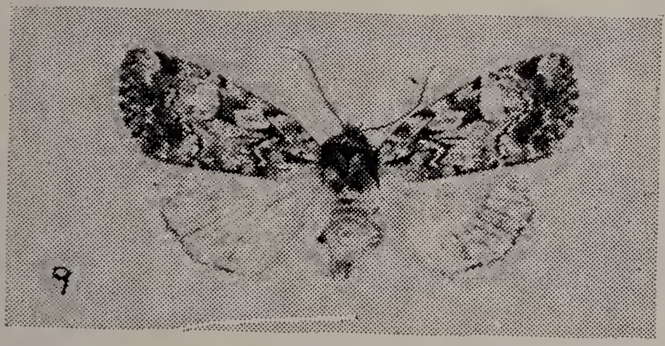
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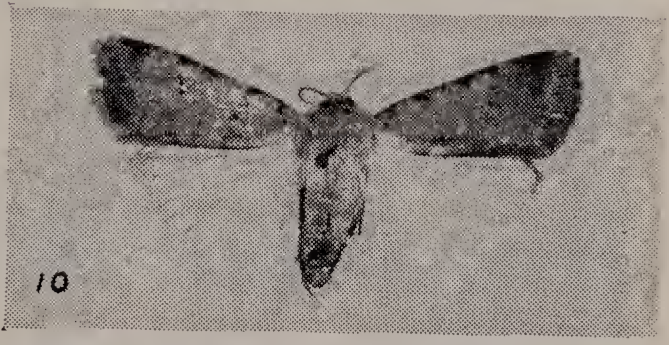
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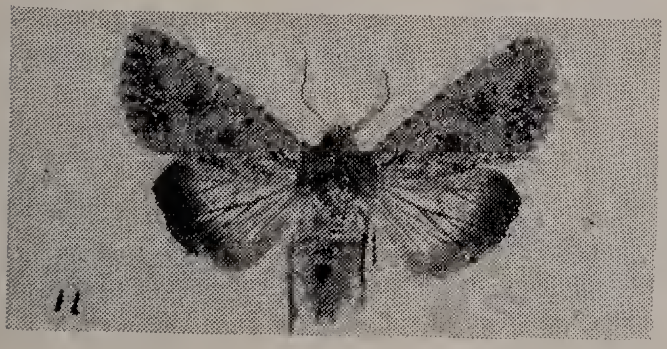
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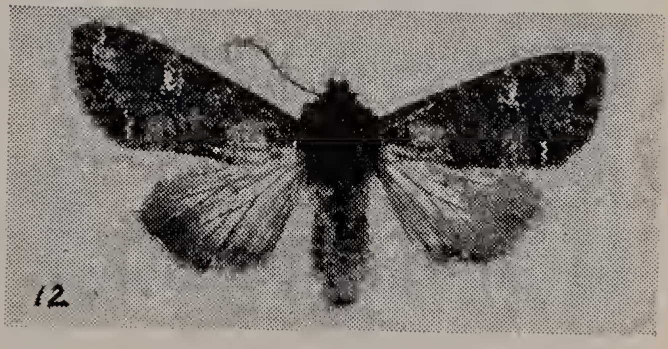
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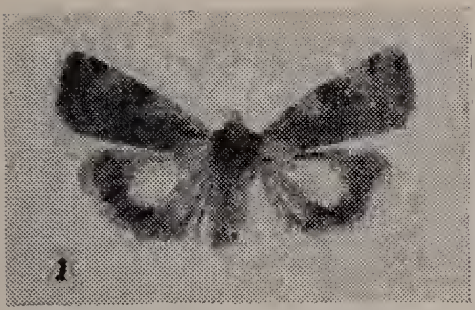
PLATE VII

1. Cryptocala acadiensis Beth. ♀, topotypical. Armdale, August 10, 1950.
2. Anarta cordigera Thun. ♂. Bog, Prospect Road, June 9, 1951.
3. Hemipachnobia monochromatea Morr. ♂. Mount Uniacke, June 15, 1950.
4. Polia rugosa Morr. ♂. Bog, Prospect Road, July 2, 1951.
5. Apharetra dentata Grt. ♀. Bog, Prospect Road, August 11, 1951.
6. Polia pulverulenta Sm. ♂. Mount Uniacke, July 18, 1946.
7. Leucania inermis Forbes ♀. South Milford, June 23, 1950.
8. Anathix puta G. & R. ♂. Armdale, September 3, 1949.
9. Oncocnemis piffardi Wlk. ♂. Digby, August 28, 1937.
10. Leucania scirpicola Gn. ♂. Lequille, June 16, 1949.
11. Oligia minuscula form grahami Benj. ♂. Peggy's Cove, September 22, 1952.
12. Hillia iris Zett. ♂. Aylesford, October 3, 1950.
13. ,, ,, form vigilans Grt. ♂. Aylesford, September 10, 1952.
14. Oligia tonsa var.? ♂. Parrsboro, July 30, 1948.
15. ,, semicana Wlk. ♂. Halifax watershed area, August 10, 1950.
16. Eremobina claudens Wlk. ♂. Mount Uniacke, August 14, 1950.
17. Spartiniphaga panatela Sm. ♂. Mount Uniacke, June 22, 1951.
18. ,, inops Grt. ♂. Annapolis Royal, September 3, 1946.
19. Hypocoena orphnina Dyar ♂. Lequille, August 21, 1946.
20. ,, inquinata Gn. ♂. Halifax watershed area, August 14, 1950.
21. Fagitana littera Gn. ♀. Lake Kejimukujik, May 29, 1950.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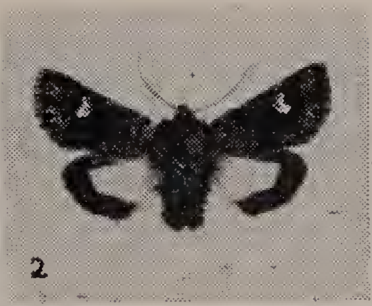
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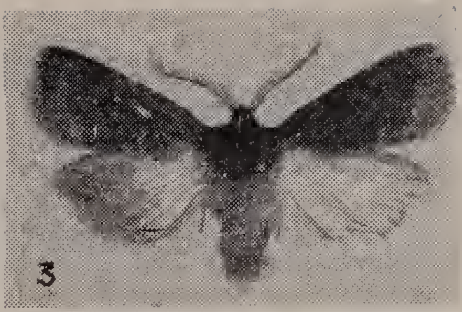
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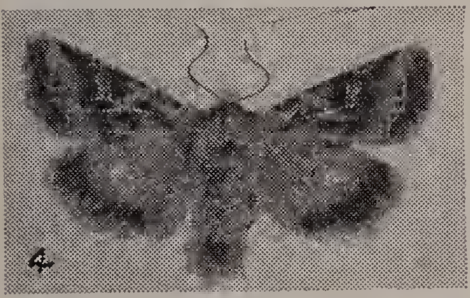
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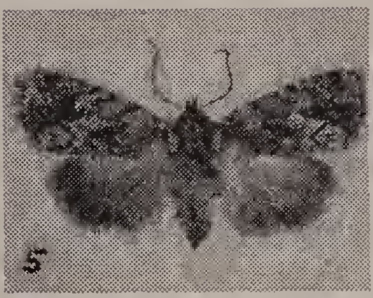
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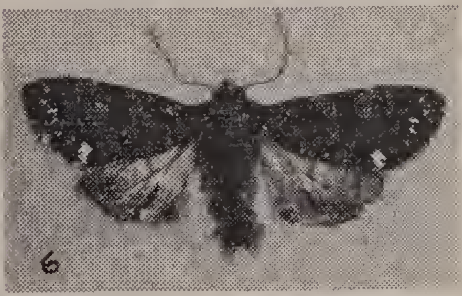
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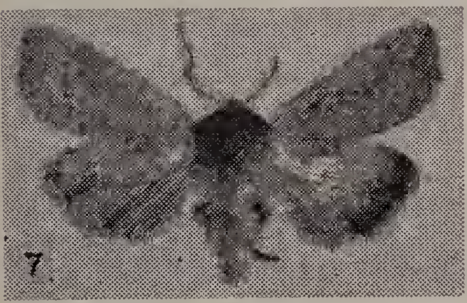
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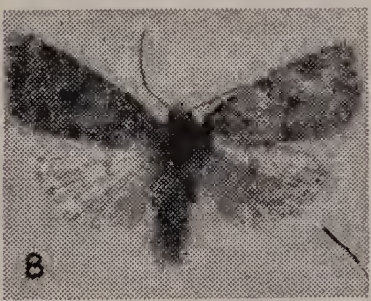
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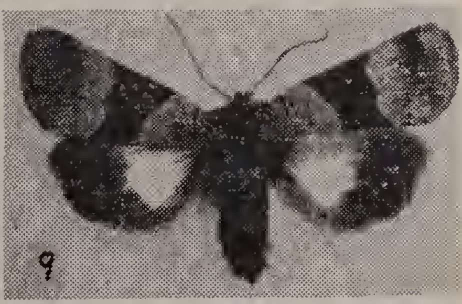
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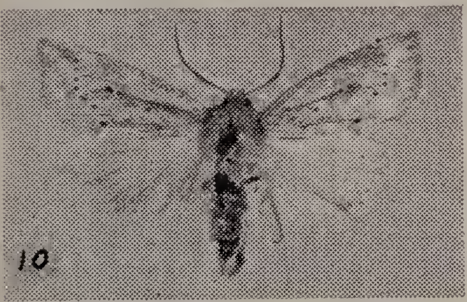
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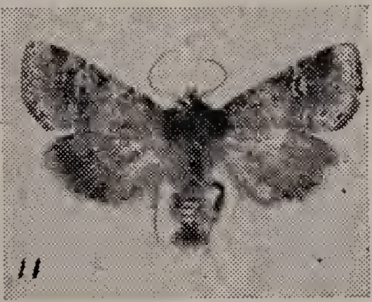
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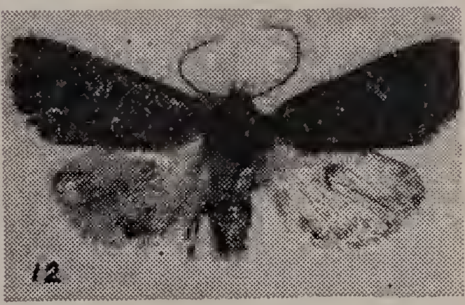
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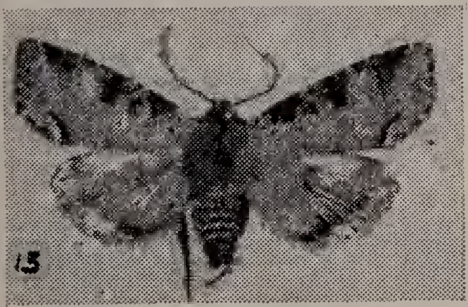
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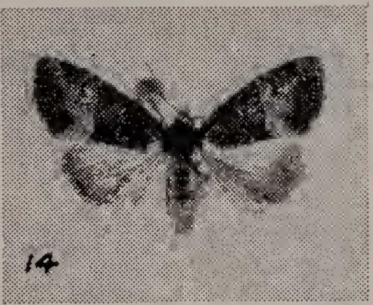
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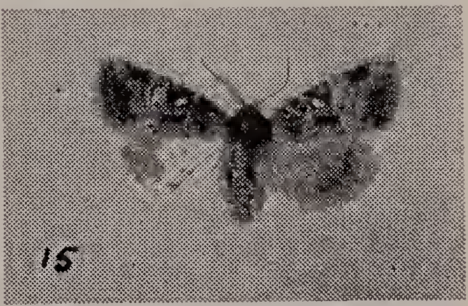
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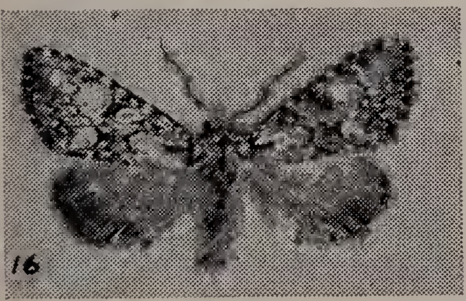
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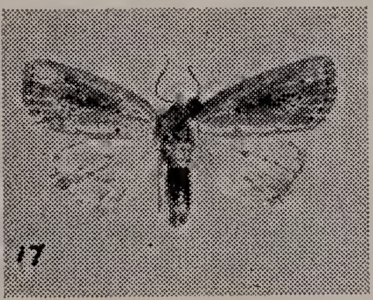
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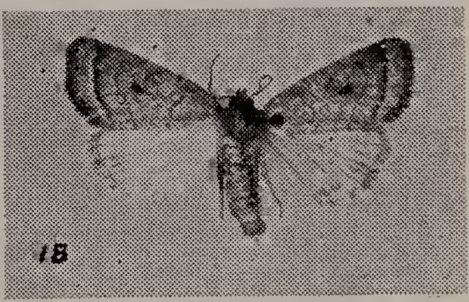
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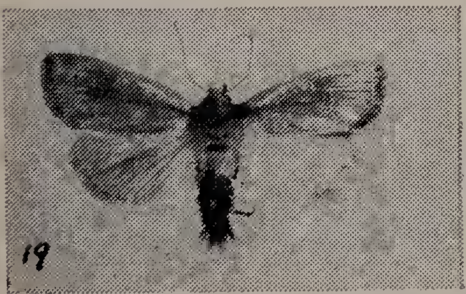
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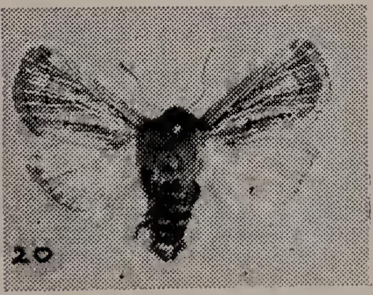
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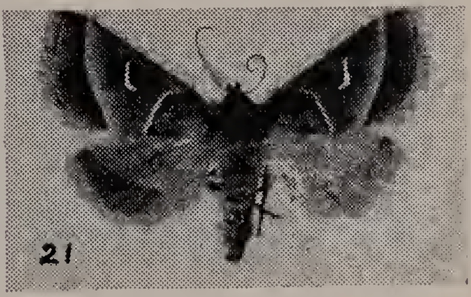
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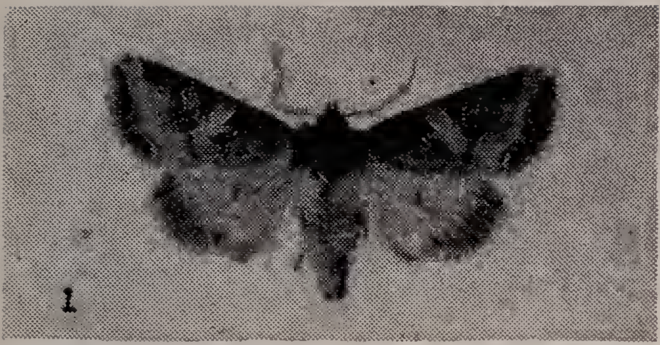
PLATE VIII

1. Polia tacoma Stkr. ♀. Aldershot, June 4, 1952.
2. ,, frustrata McD. ♂. Mount Uniacke, June 7, 1950.
3. ,, ingravis Sm. ♂. Mount Uniacke, June 7, 1948.
4. Xylomyges dolosa Grt. ♀. Waverley, May 22, 1949.
5. Sideridis rosea Harv. ♂. Aylesford, June 3, 1951.
6. ,, congermana Morr. ♂. MacNab's Island, July 23, 1907.
7. Orthosia rubescens Wlk. ♂. Armdale, May 2, 1949.
8. Adita chionanthi A. & S. ♀. Digby, September 19, 1907.
9. Cucullia florea Gn. ♂. Annapolis Royal, bred from larva on *Aster umbellatus*.
10. ,, postera Gn. ♂. Round Hill, July 21, 1938.
11. Feralia major Sm. ♂. Digby, 1933.
12. ,, comstocki Grt. ♂. Brown suffused form. Mount Uniacke May 20, 1952.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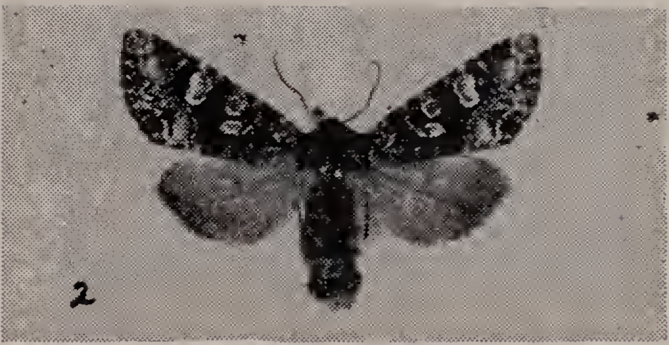
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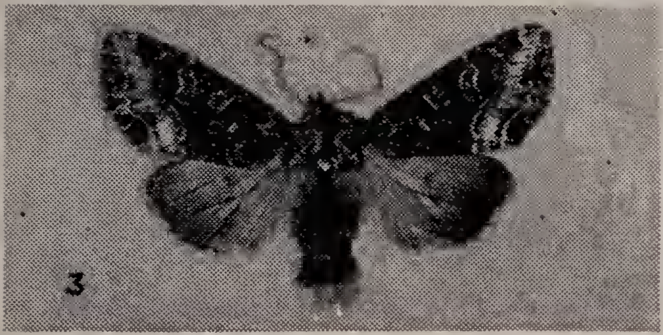
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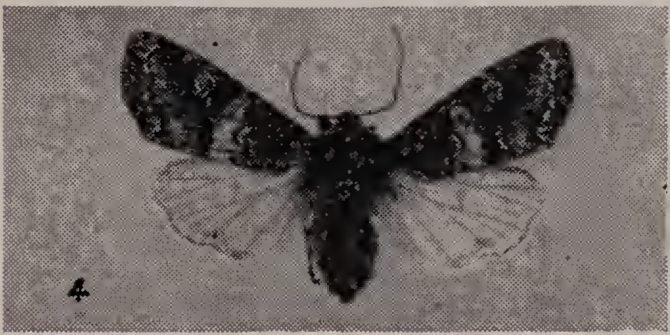
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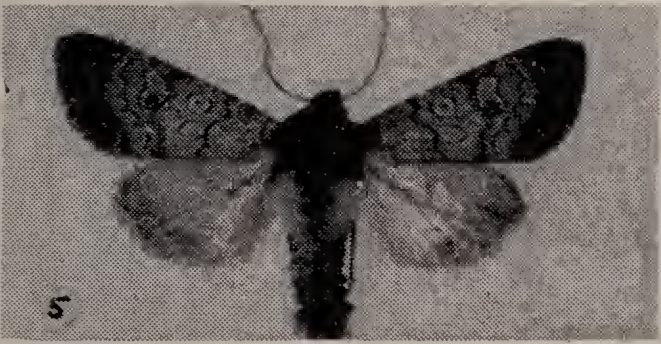
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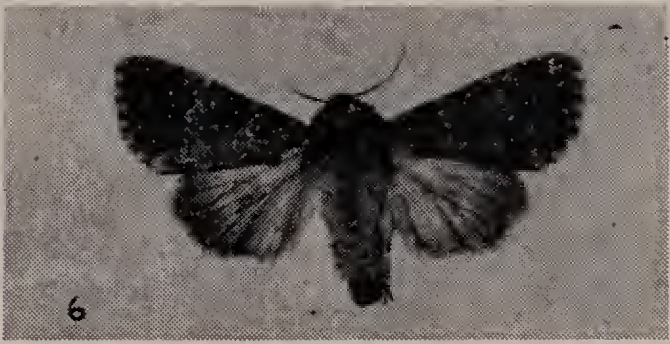
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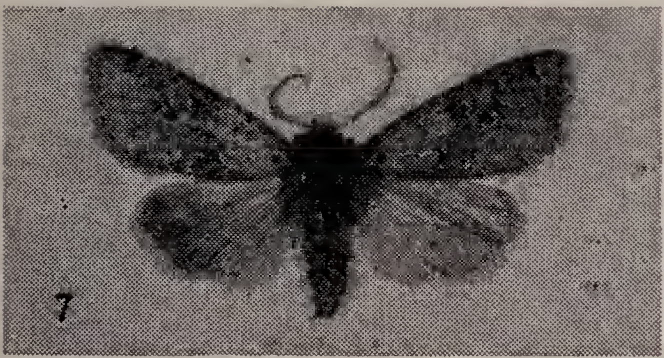
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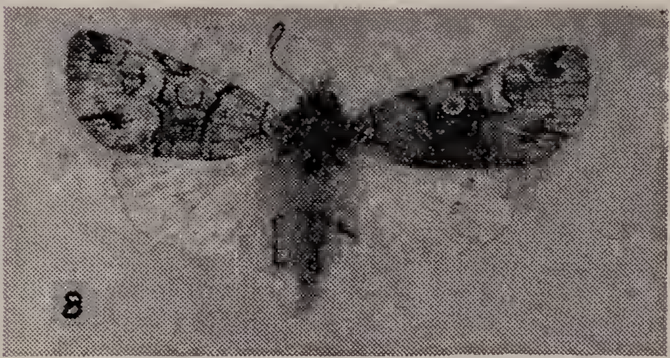
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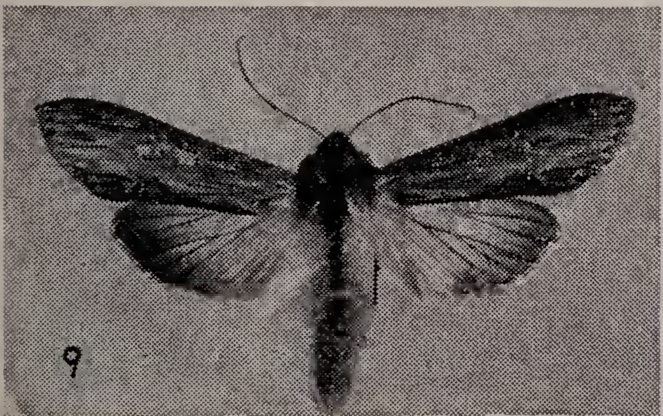
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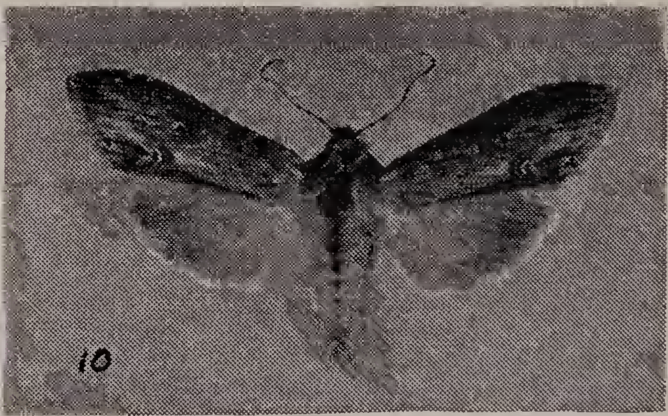
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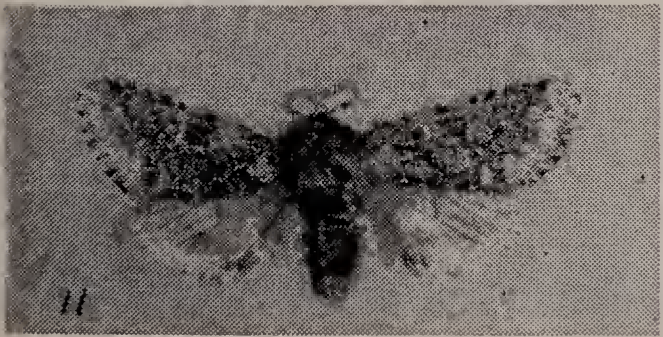
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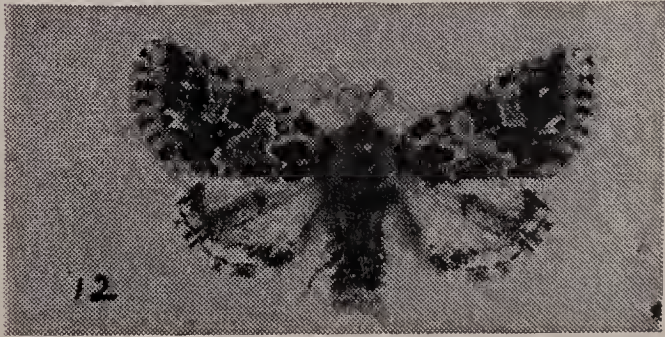
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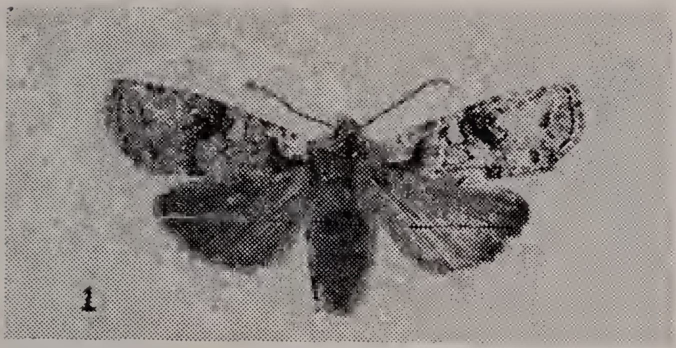
PLATE IX

1. Lithophane baileyi Grt. ♀. Wellington, October 9, 1950.
2. ,, tepida Grt. ♂. Peggy's Cove, September 20, 1952.
3. ,, georgii Grt. ♂. Centreville, October 2, 1950.
4. ,, lepida Lint. ♂. Armdale, April 13, 1945.
5. Xylina thoracica Put.—Cram. ♂. Armdale, October 1, 1950.
6. ,, cineritia Grt. ♂. Armdale, April 13, 1945.
7. Xylotype acadia B. & B. ♀. Armdale, September 3, 1949.
8. Mniotype ducta Grt. ♀. Digby, June 28, 1905.
9. Fishea enthea Grt. ♂. Debert, September 24, 1952.
10. Septis apamiformis Gn. ♀. Centreville, July 22, 1949.
11. ,, mixta Grt. ♀. Parrsboro, August 15, 1944.
12. ,, plutonia Grt. ♂. Valley of the Cheticamp River, July 2, 1949.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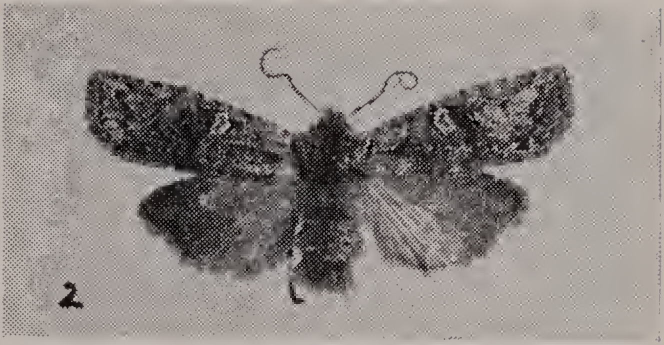
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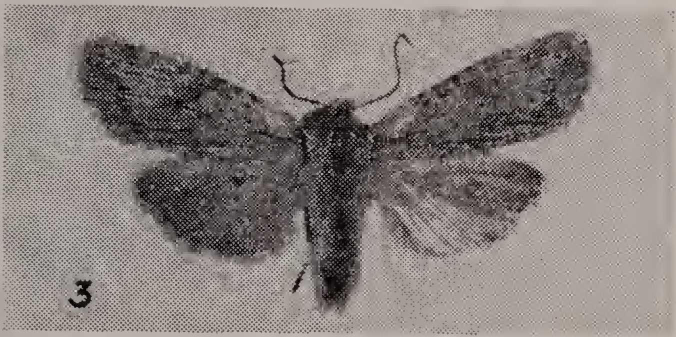
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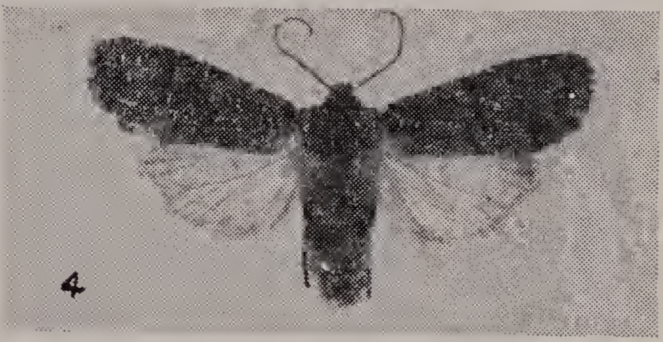
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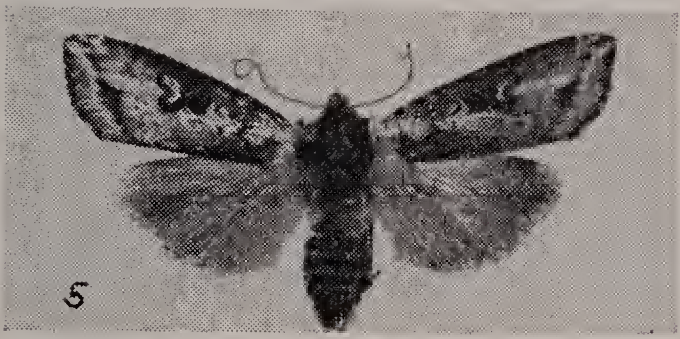
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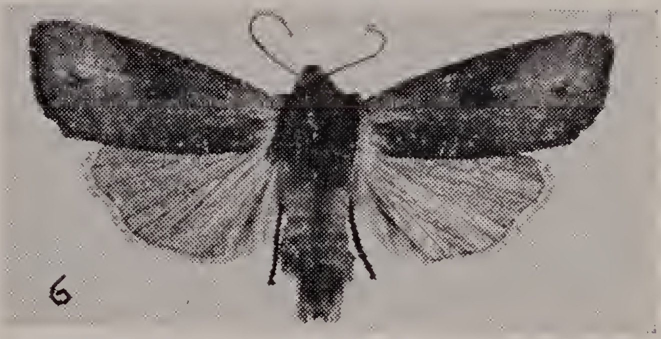
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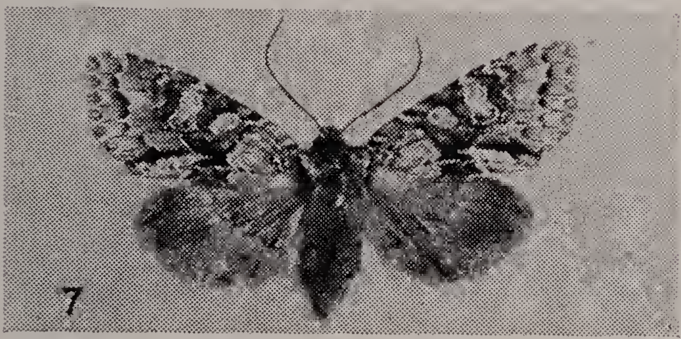
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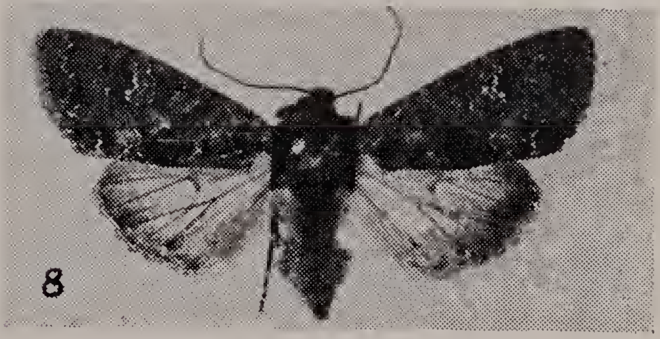
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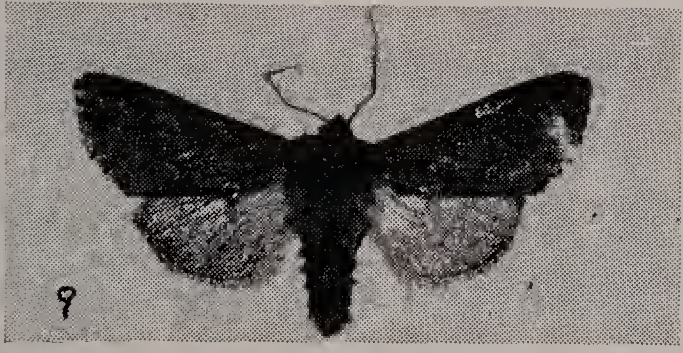
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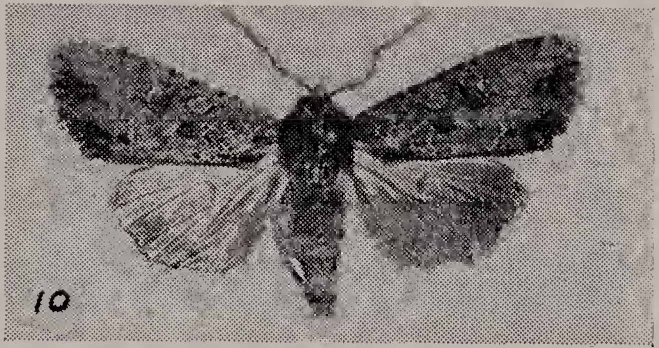
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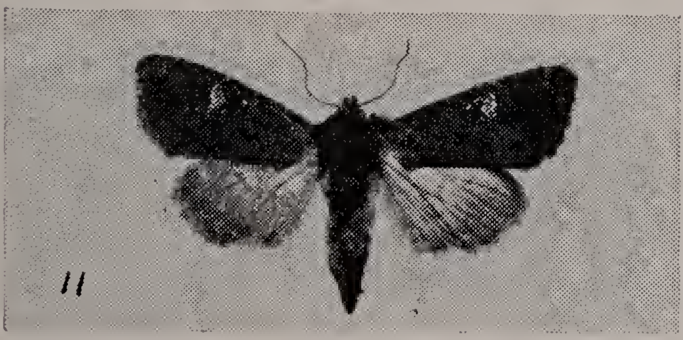
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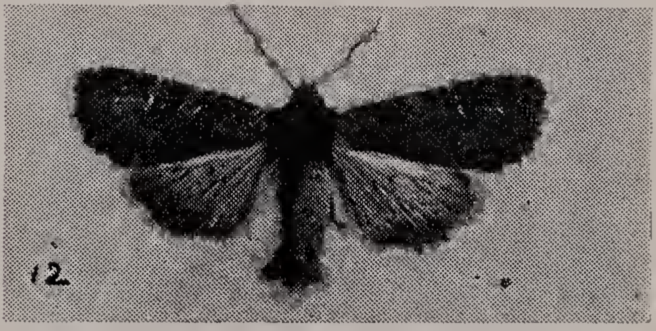
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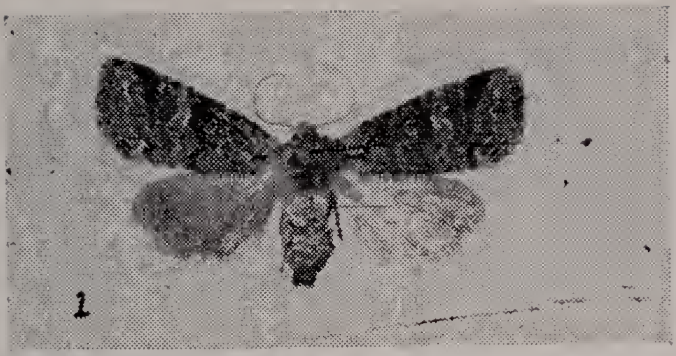
PLATE X

1. Bombycia algens Grt. ♀. Aylesford, September 2, 1951.
2. Archanara subflava Grt. ♂. Wolfville, August 12, 1945.
3. Andropolia contacta Wlk. ♂. Glenville, August 9, 1949.
4. Enargia infumata Grt. ♀. Glenville, August 11, 1949.
5. Syngrapha microgramma Hbn. ♂. Peggy's Cove, June 22, 1952.
6. ,, altera variana Ottol. ♂. Armdale, July 15, 1949.
7. ,, octoscripta Grt. ♂. Halifax watershed area, August 10, 1950.
8. ,, surena Grt. ♀. French Mountain, August 20, 1952.
9. Autographa rubida Ottol ♂. Centreville, June 2, 1951.
10. ,, mappa G. & R. ♂. Annapolis Royal, June 19, 1928.
11. Catocala crataegi Saund. ♀. Waverley, August 23, 1948.
12. ,, connubialis Gn. ♂. Coldbrook, July 23, 1949.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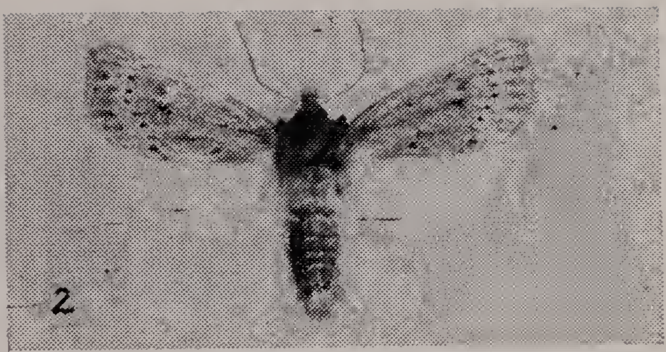
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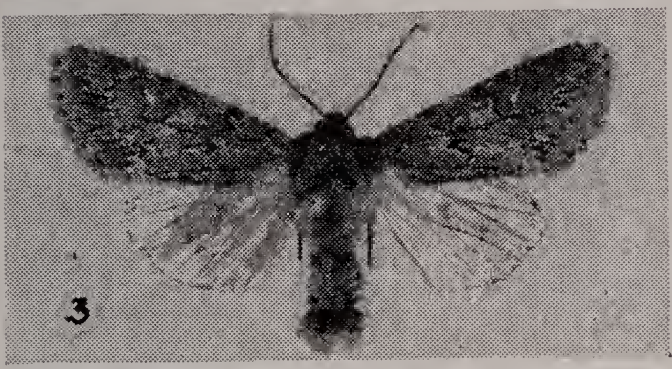
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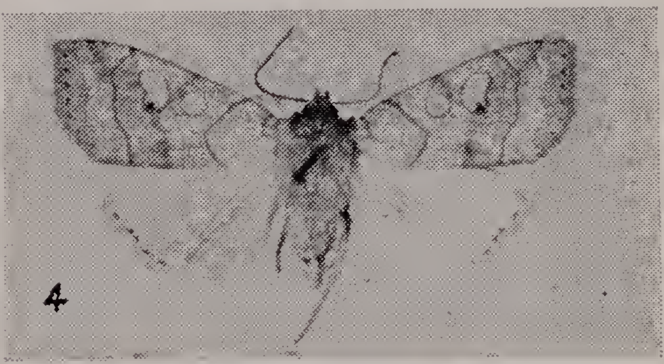
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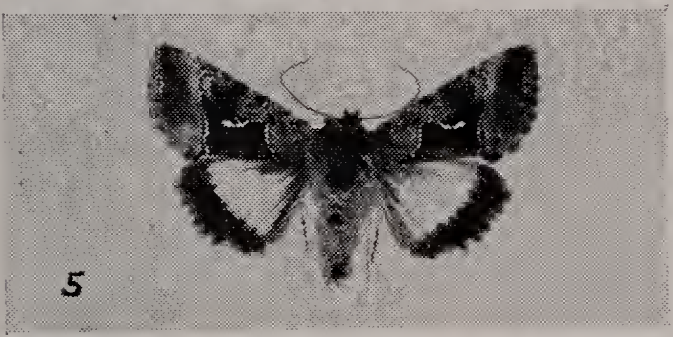
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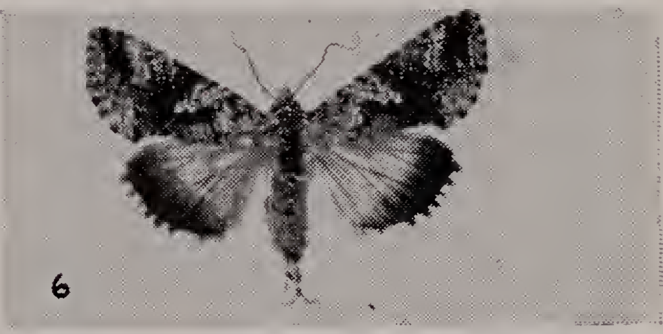
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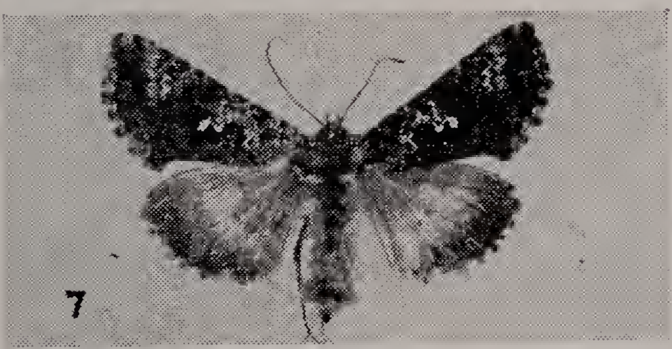
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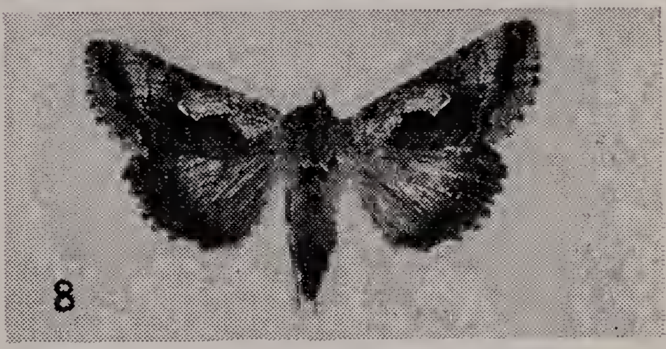
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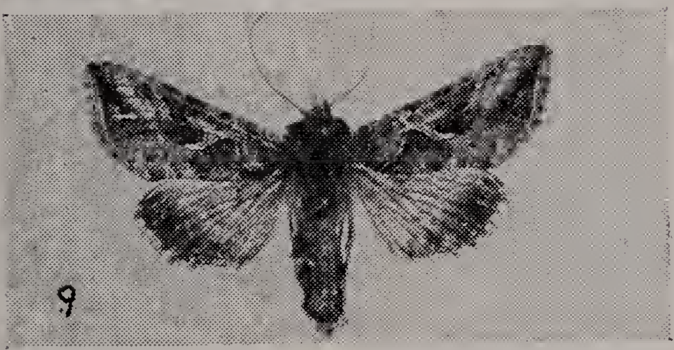
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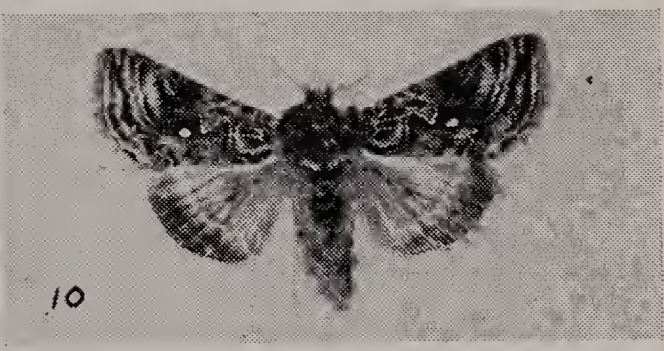
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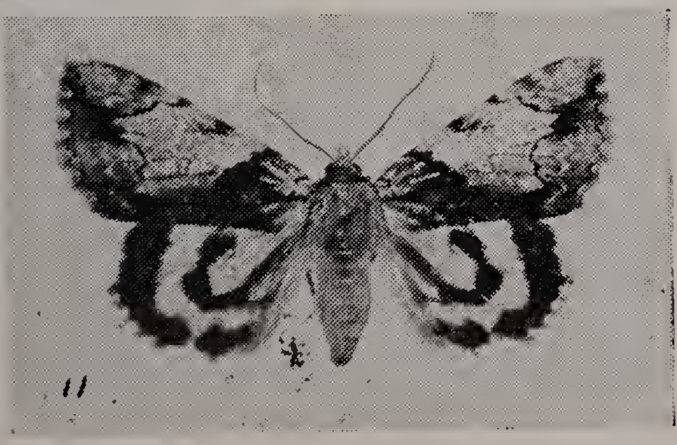
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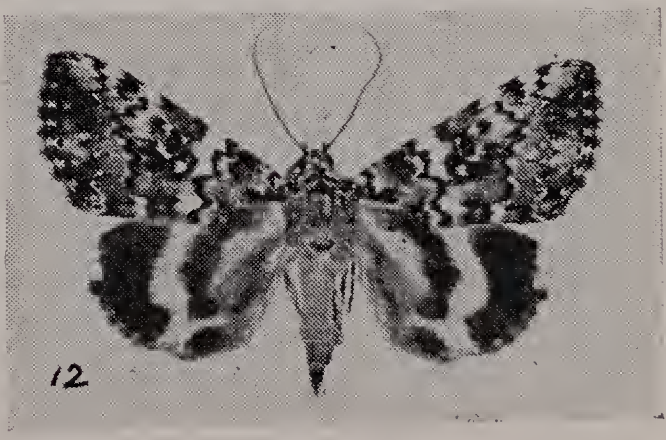
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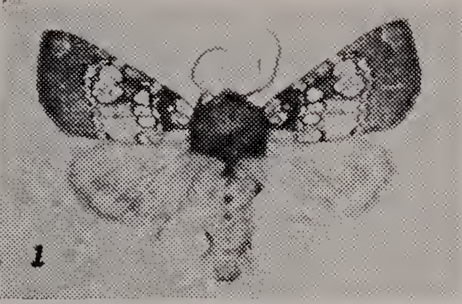
PLATE XI

1. Papaipema appassionata Harv. ♂. Peggy's Cove, September 18, 1952.
2. Paectes oculatrix Gn. ♀. Annapolis Royal, June 14, 1949.
3. Papaipema eupatorii Lyman ♂. Aylesford, October 3, 1950.
4. ,, inquaesita G. & R. ♂. Armdale, October 2, 1948.
5. Elaphria georgei Moore & Rawson ♂. Mount Uniacke, June 1, 1951.
6. Papaipema frigida Sm. ♂. Aylesford, October 3, 1950.
7. Cerma cora Hbn. ♀. Mount Uniacke, July 10, 1951.
8. Eutricopis nexilis Morr. ♂. Sackville, May 20, 1951.
9. Schinia nundina Dru. ♂. Lawrencetown, August 24, 1945.
10. Marathyssa inficita Wlk. ♂. Annapolis Royal, June 16, 1949.
11. Nycteola frigidana Wlk. ♀. Baddeck, bred from larva on willow.
12. Pseudoplusia oo Cram. ♀. Wellington, October 12, 1950.
13. Bomolocha citata Grt. ♂. Armdale, October 18, 1947.
14. Parahypenodes quadralis B. & McD. ♂. Halifax watershed area, August 31, 1950.
15. Epizeuxis sp. near aemula ♂. Mount Uniacke, August 18, 1950.
16. ,, ,, ,, ,, ♂. Dark variety from Cape Breton Island, Baddeck, August 4, 1950.
17. ,, rotundalis Wlk. ♀. underside. Armdale, August 11, 1948.
18. ,, julia B. & McD. ♀, underside. Glenville, July 29, 1948.
19. ,, laurenti Sm. ♂. Waverley, July 21, 1950.
20. Zanclognatha pedipilalis Gn. ♀. Cole Harbour, July 23, 1951.
21. Philometra hanhami Sm. ♂. Halifax watershed Area, August 14, 1950.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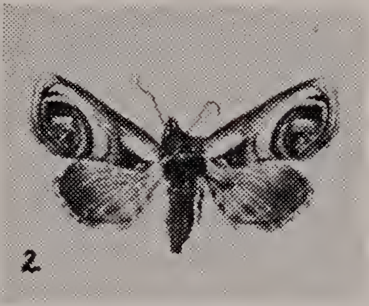
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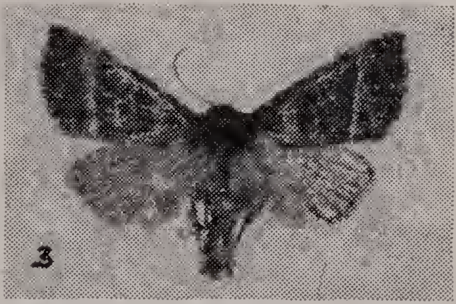
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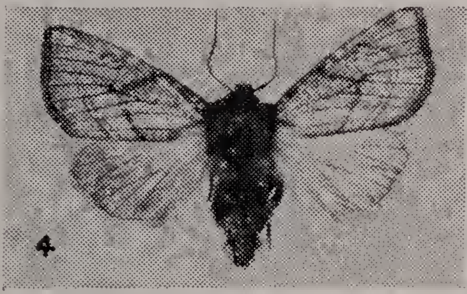
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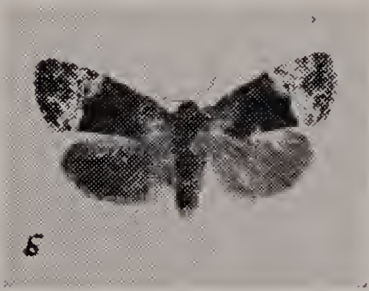
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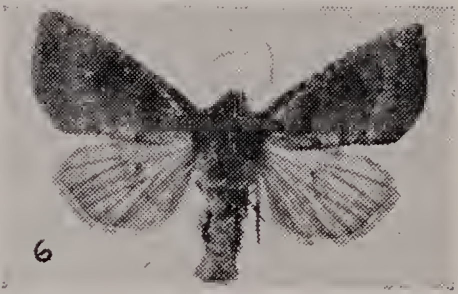
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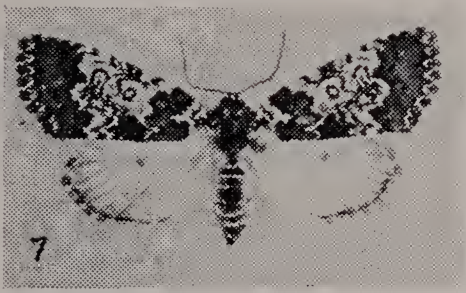
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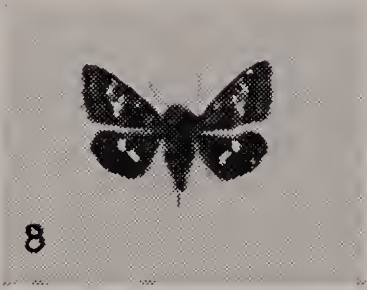
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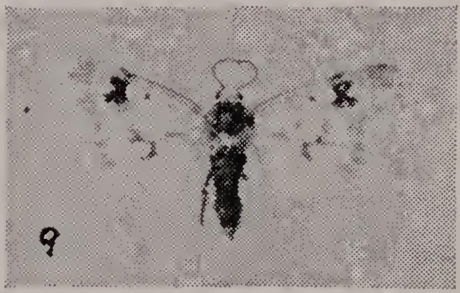
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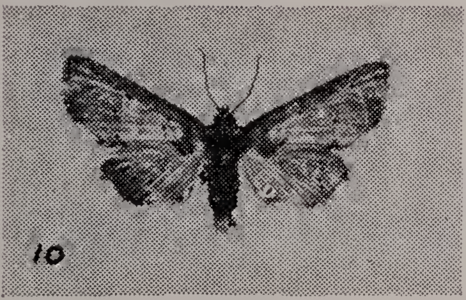
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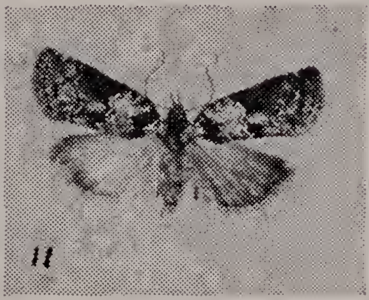
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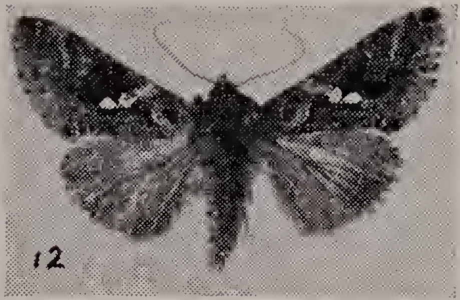
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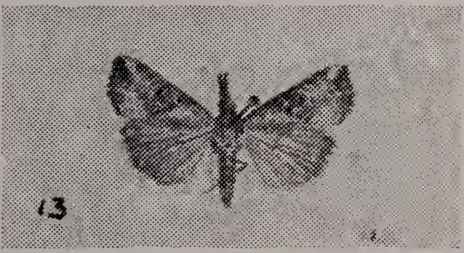
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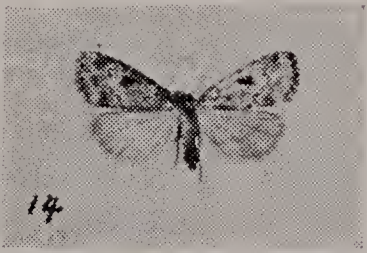
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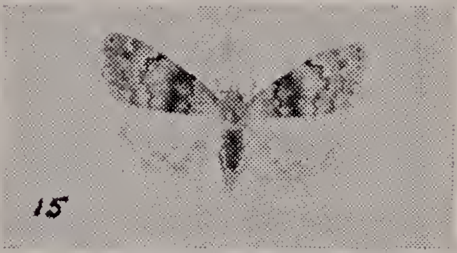
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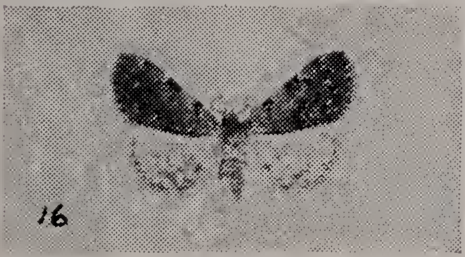
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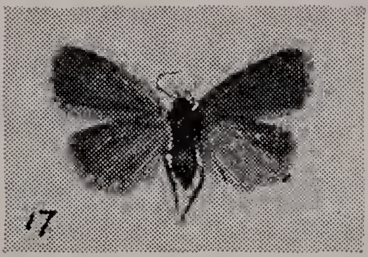
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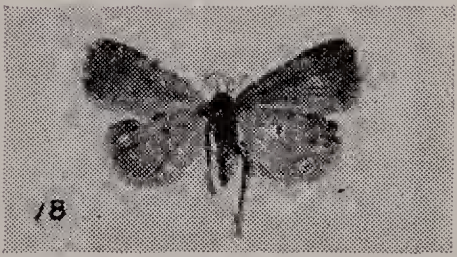
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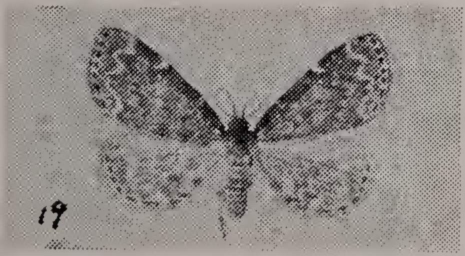
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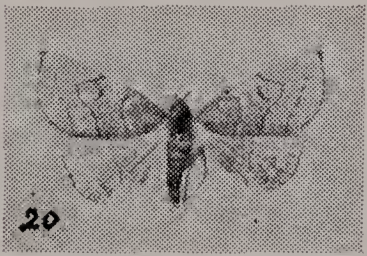
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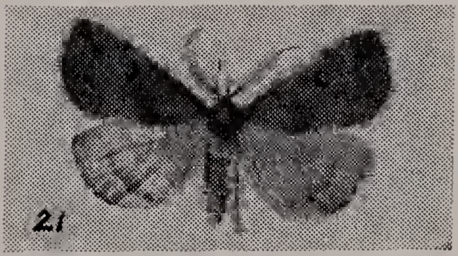
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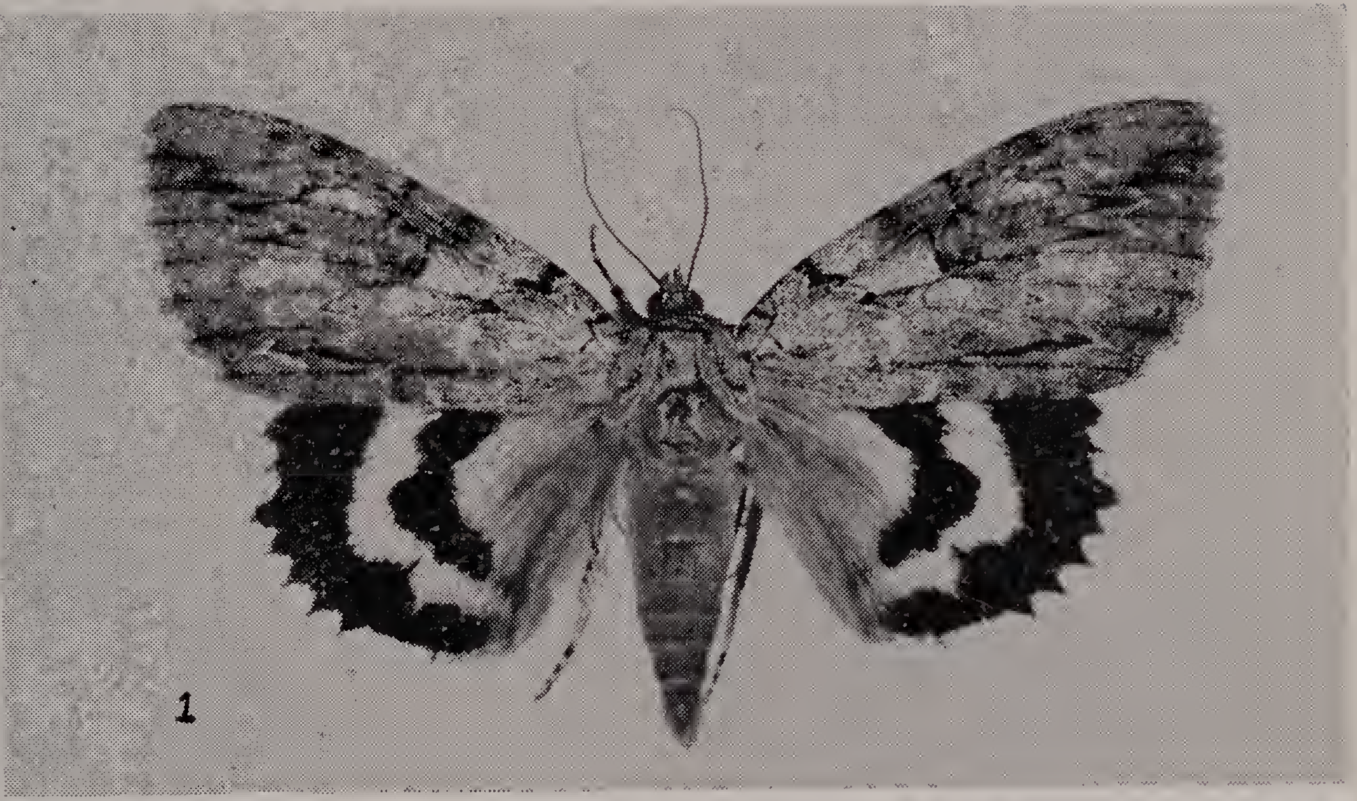
PLATE XII

1. Catocala subnata Grt. ♂. Fleming Glen, Halifax, August 13, 1944.
2. ,, coccinata Grt. ♂. Halifax watershed area, August 21, 1949.
3. Gluphisia avimacula form slossoniae Pack. ♂. Halifax watershed area, June 23, 1948.
4. ,, lintneri Grt. ♂. Debert, N. S., May 19, 1952.
5. Symmerista albifrons A. & S. ♂. MacNab's Island, June 30, 1908.
6. ,, leucitys Franclemont ♂. Lequille, bred from larva on maple.
7. ,, canicosta Franclemont ♂. Armdale, July 6, 1948.



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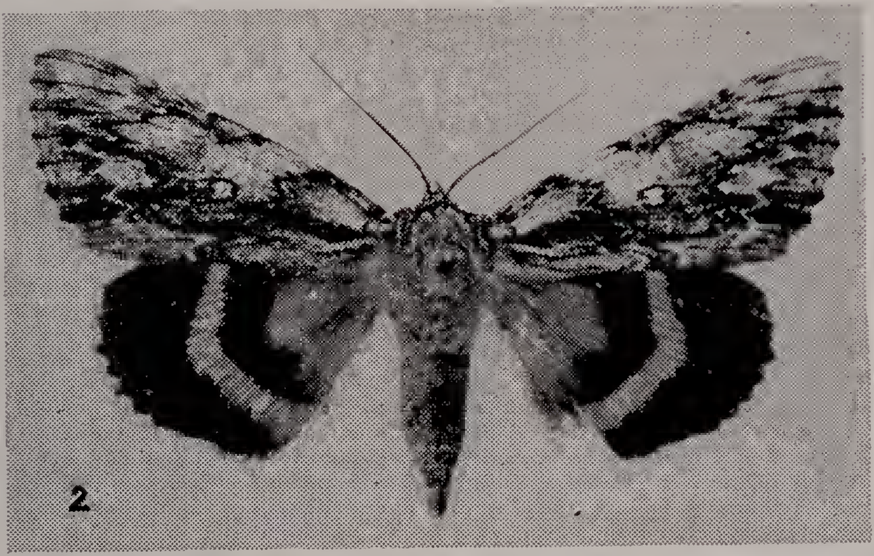

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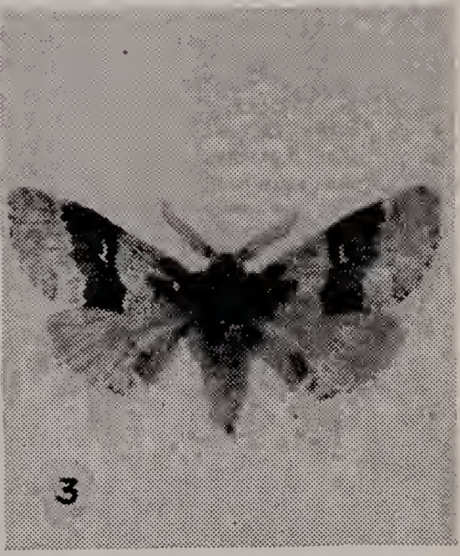

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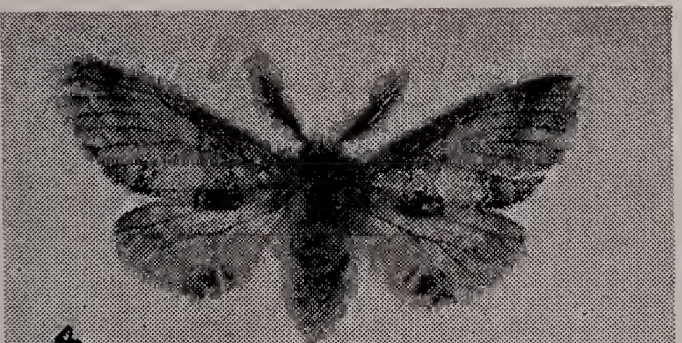

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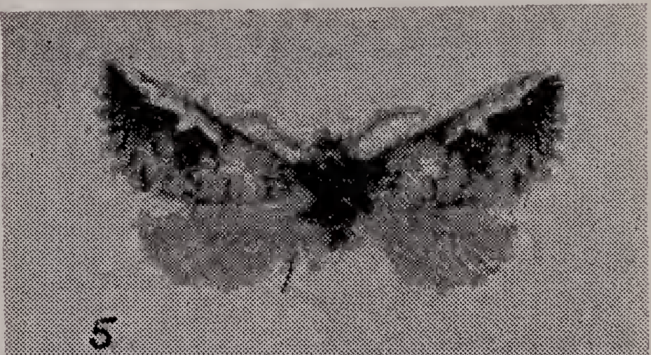

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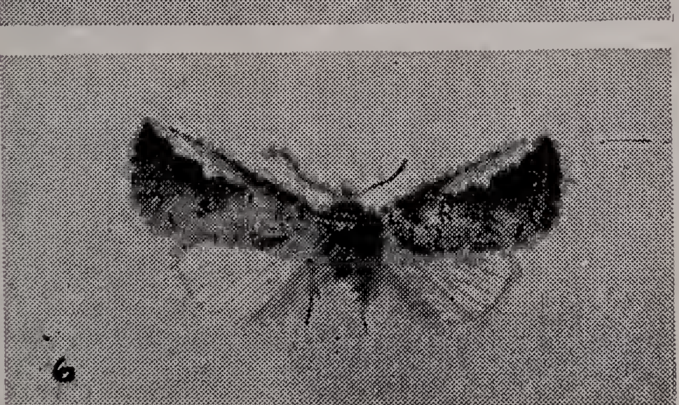

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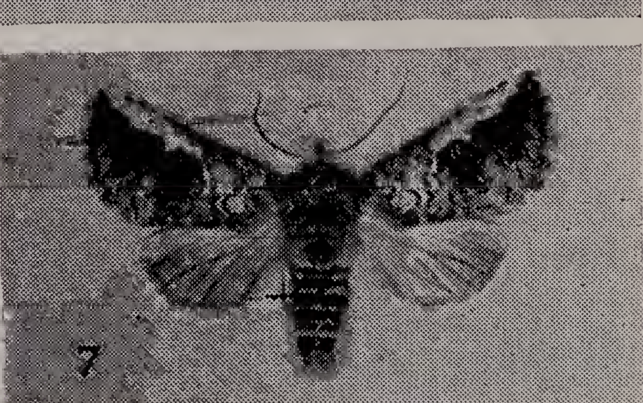

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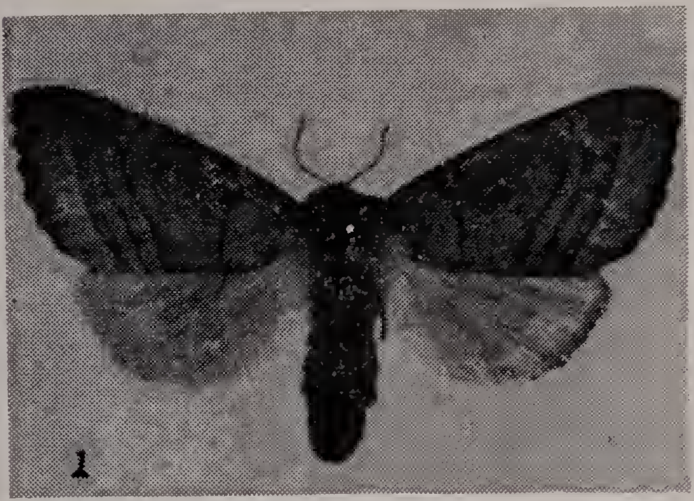
PLATE XIII

1. Datana major G. & R. ♀. Annapolis, July 7, 1946.
2. Heterocampa obliqua Pack. ♀. Annapolis, July 31, 1946.
3. Notodonta simplaria Graef ♂. Lake Rossignol, Aug. 20, 1951.
4. Gluphisia avimacula Hud. ♂. Armdale, June 22, 1948.
5. Heterocampa guttivitta Wlk. ♂. Topotypical. Armdale, June 20, 1948.
6. Cerura scolopendrina var. ♀. Bedford, July 24, 1944.
7. Dasychira plagiata Wlk. ♂. Halifax watershed, July 26, 1952.
8. ,, dorsipennata B. & McD. ♂. Auburn, June 30, 1951.
9. vagans B. & McD. Dark var. ♀. Centreville, July 26, 1950.
10. ,, ,, Dark var. ♂. Waverley, July 21, 1950.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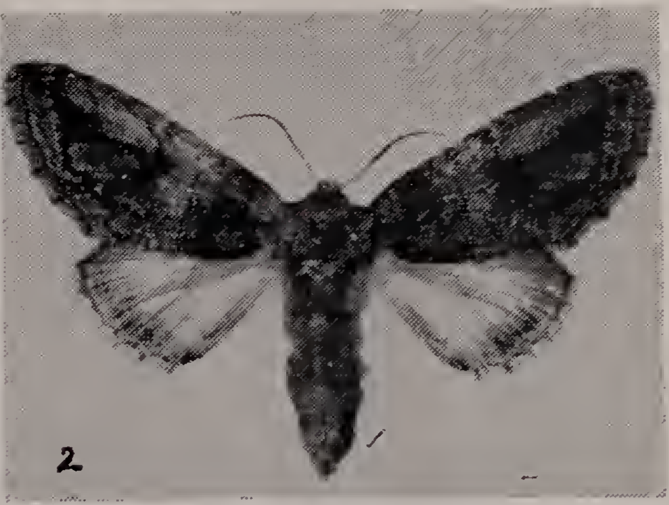
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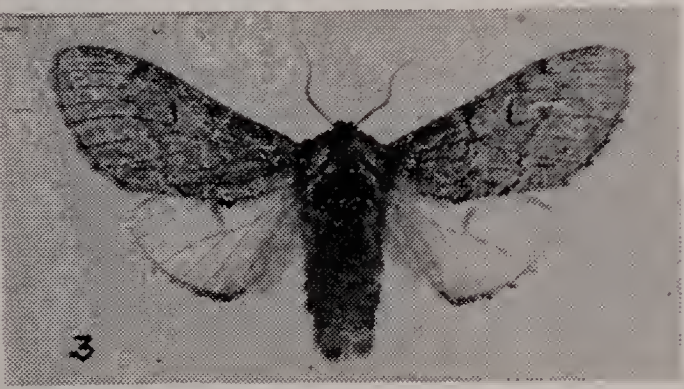
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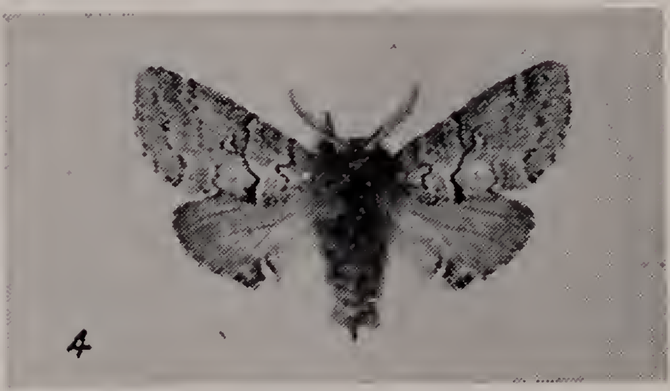
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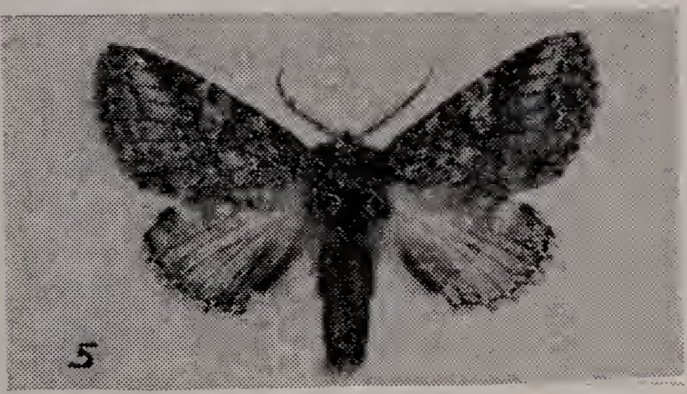
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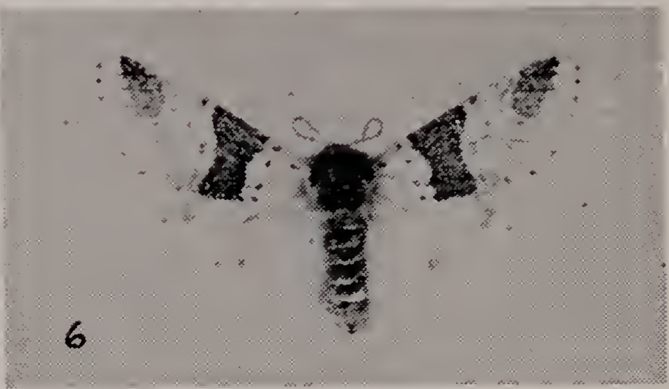
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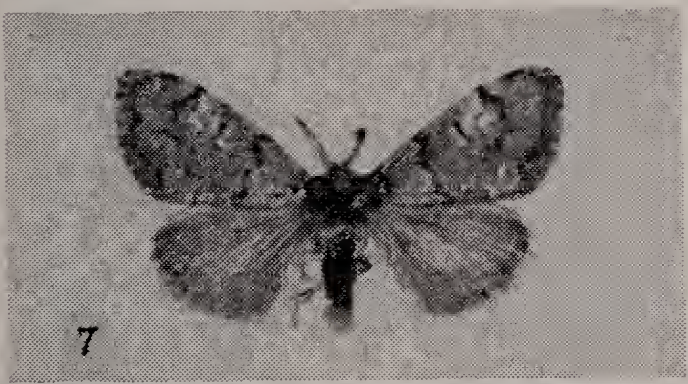
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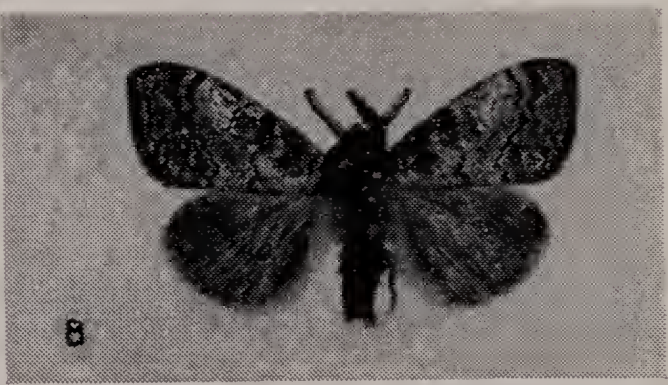
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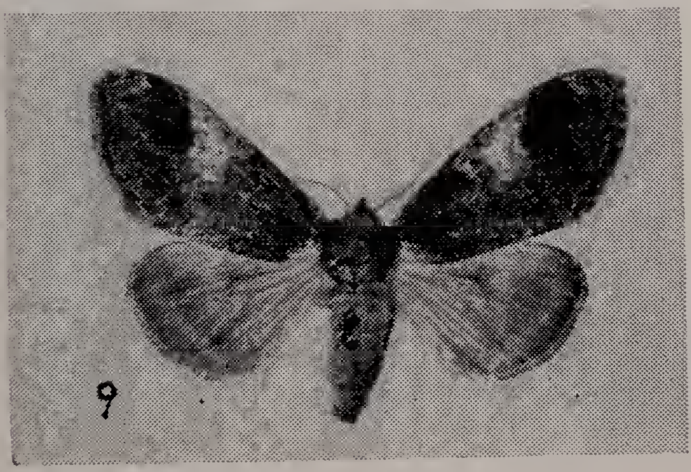
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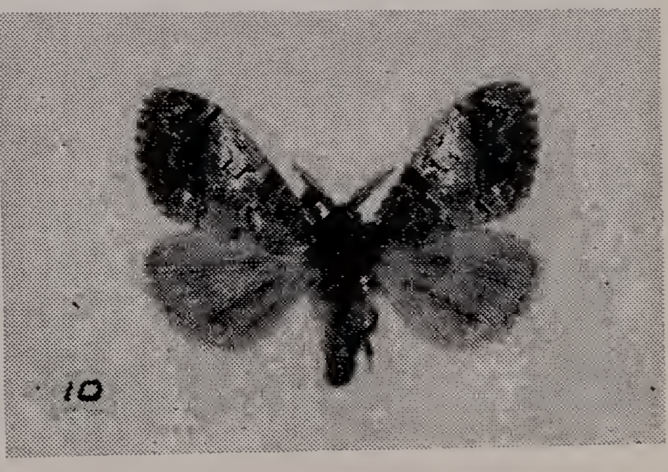
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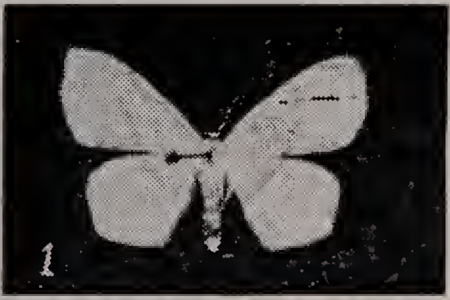
PLATE XIV

1. Scopula junctaria Wlk. ♂. Clementsvale, June 29, 1951.
2. ,, persimilis Hlst. ♂. Mount Uniacke, June 22, 1951.
3. ,, inductata sobria Wlk. ♂. South Milford, June 27, 1951.
4. Sterrha rotundopennata Pack. ♀. South Milford, June 27, 1951.
5. Carsia paludata thaxteri Swett ♀. Bog, Prospect Road, July 23, 1952.
6. Acasis viridata Pack. ♂. Halifax watershed area, May 9, 1951.
7. Nyctobia atroliturata Wlk. ♀. Topotypical Mount Uniacke, May 25, 1950.
8. ,, limitaria Wlk. ♂. Dark variant Halifax watershed area, May 7, 1951.
9. ,, limitaria Wlk. ♀. Pale variant. Halifax watershed area, May 25, 1952.
10. Operophtera bruceata Hlst. ♂. Glenholme, November 13, 1951.
11. Plemyria georgii Hlst. ♂. Halifax watershed area, August 31, 1950.
12. Thera juniperata L. ♀. Halifax, bred August 30, 1950.
13. Eupithecia palpata Pack. ♀ Lequille, June 22, 1950.
14. ,, transcanadata MacKay ♀. Peggy's Cove, June 22, 1952.
15. ,, albipunctata Haw. ♀. Cheticamp River, July 2, 1949..
16. ,, arceuthata taylorata Swett ♂. Aldershot, June 4, 1952,
17. ,, nimbicolor Hlst. ♀. Peggy's Cove, June 22, 1952.
18. ,, fumosa Hlst. ♀. Acaciaville, June 15, 1949.
19. ,, gelidata Moesch. ♂. Bog, Prospect Road, August 11 1951.
20. ,, filmata Pears. ♂. Prospect Road, April 23, 1952.
21. ,, albicapitata Pack. ♀. South Milford, June 27, 1951.
22. ,, ravocostaliata Pack. ♂. Mount Uniacke, bred April 10, 1952.
23. ,, anticaria Wlk. ♂. Topotypical. Auburn, June 30, 1951.
24. Venusia comptaria Wlk. ♂. Topotypical. Mount Uniacke, May 20, 1952.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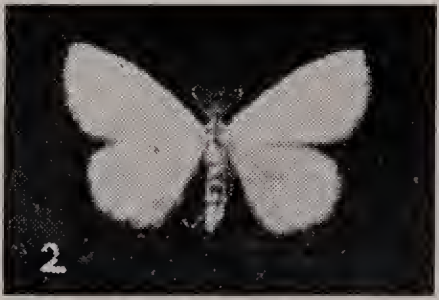
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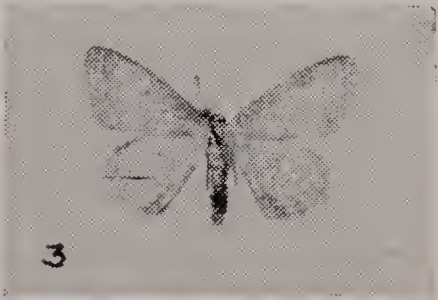
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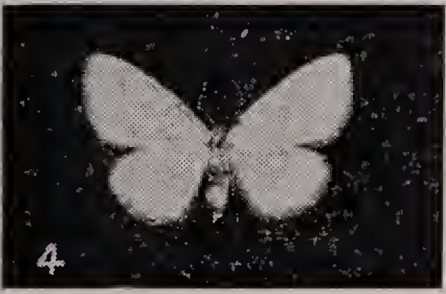
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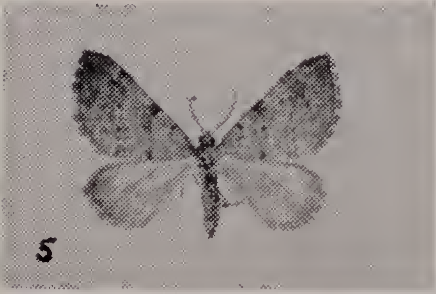
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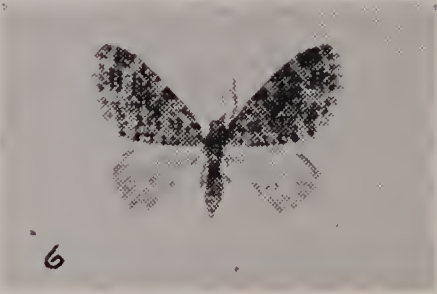
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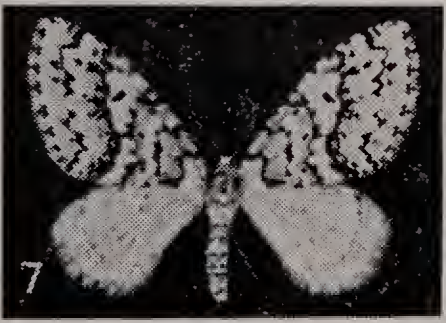
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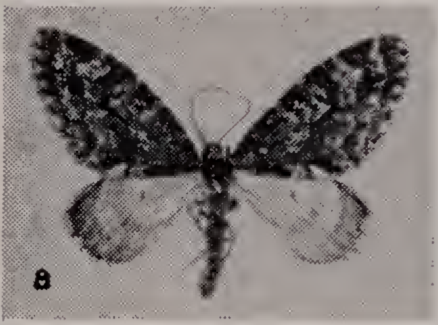
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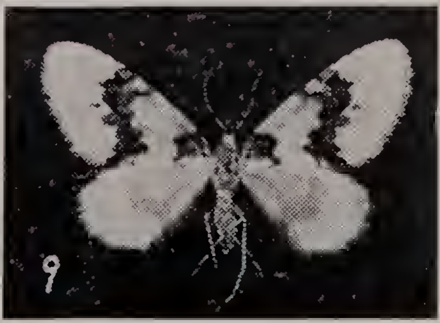
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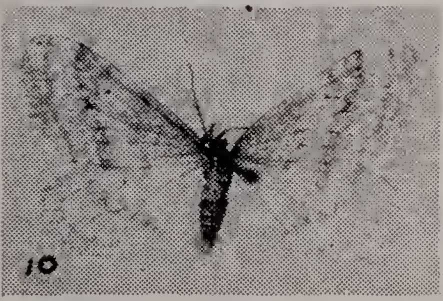
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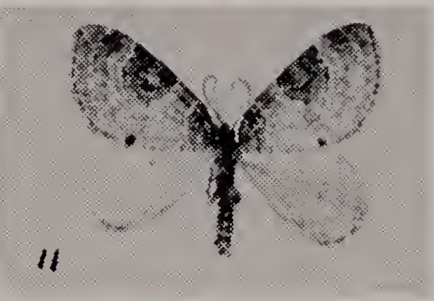
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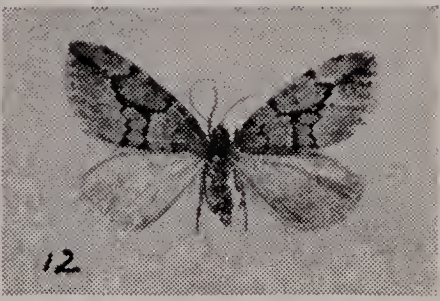
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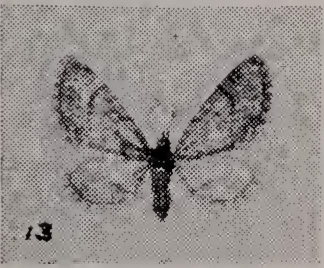
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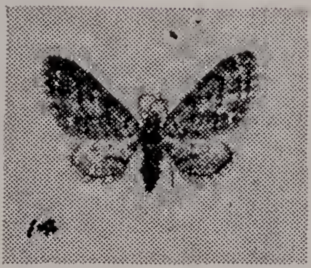
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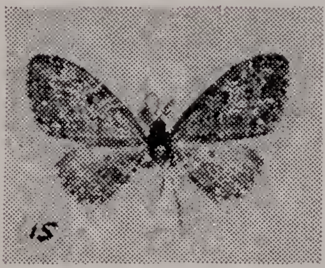
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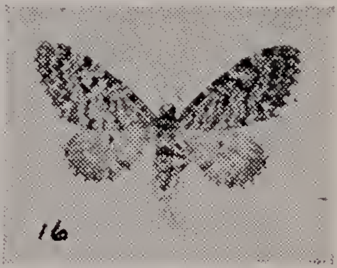
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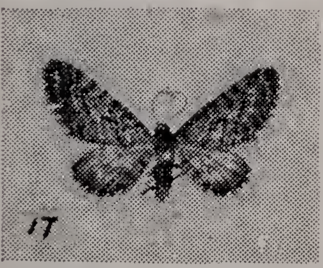
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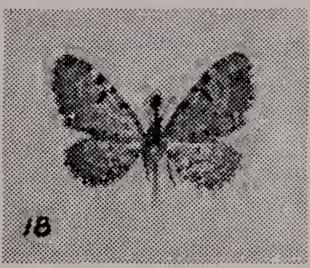
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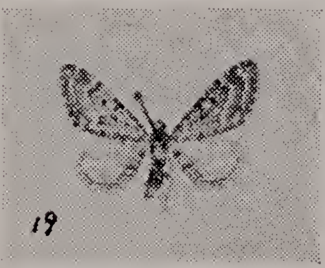
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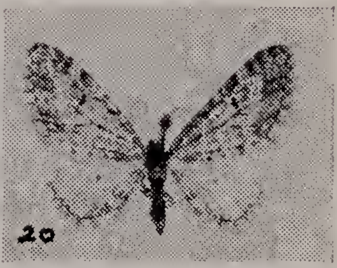
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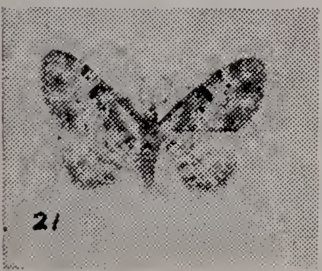
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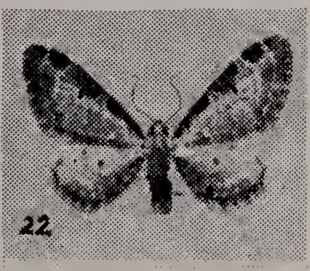
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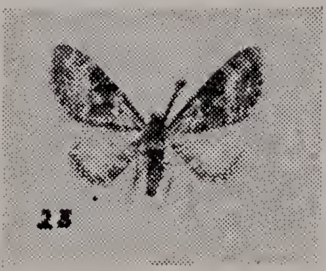
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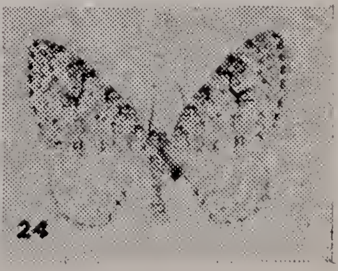
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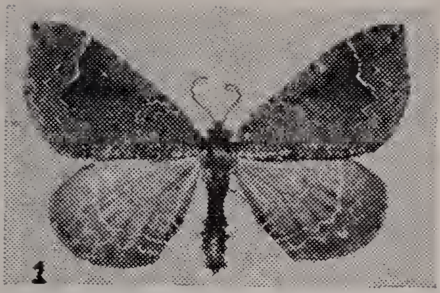
PLATE XV

1. Lygris flavibrunneata unicolorata McD. ♂. Dorchester, N. B. August 7, 1951.
2. ,, propulsata Wlk. ♂. Shad Bay, July 27, 1952.
3. ,, explanata cunigerata Wlk. ♂. Topotypical. Armdale, August 11, 1948.
4. Hydriomena furcata Thun. Holotype ♂ of new race in MS (McD.) Peggy's Cove, August 20, 1952.
5. ,, frigidata Wlk. Topotypical. Port Wallis, June 21, 1952.
6. ,, transfigurata Swett ♀. Lequille, June 13, 1949.
7. Xanthorhoe abrasaria congregata Wlk. ♂. Bog, Prospect Road, July 3, 1951.
8. ,, munitata Hbn. ♂. Parrsboro, July 30, 1948.
9. Percnoptilota evansi McD. ♀. Baddeck, June 29, 1947.
10. Eulype hastata gothicata Gn. ♂. Baddeck, July 3, 1947.
11. ,, subhastata Nolc. ♀. Mount Uniacke, June 26, 1948.
12. Bapta glomeraria Grt. ♂. Mount Uniacke, May 20, 1952.
13. Semiothisa distribuaria Hbn. ♀. Armdale, July 9, 1945.
14. ,, oweni Swett ♂. Halifax watershed area, July 6, 1951.
15. ,, perplexa McD. ♂. Glenville, July 12, 1949.
16. ,, mellistrigata Grt. ♂. Coldbrook, July 27, 1950.
17. ,, gnophosaria Gn. ♂. Lequille, July 24, 1949.
18. Aethalura anticaria Wlk. ♂. Topotypical. Waverley, May 22, 1950.
19. Itame bitactata Wlk. ♀. MacNab's Island, July 30, 1906.
20. Orthofidonia tinctaria Wlk. ♂. Armdale, May 27, 1948.
21. ,, flavivenata Hlst. ♂. Waverley, May 22, 1950.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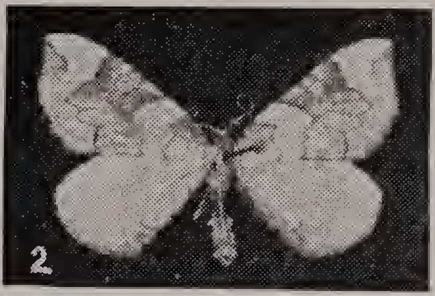
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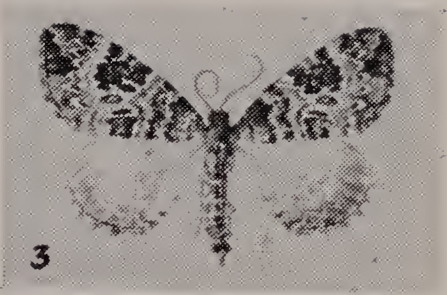
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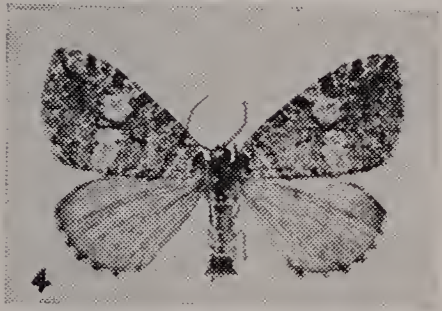
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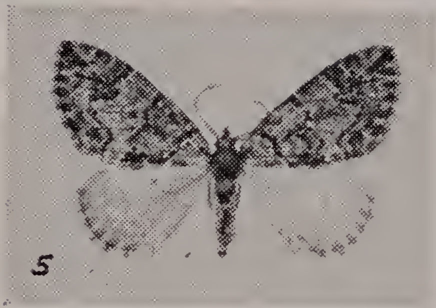
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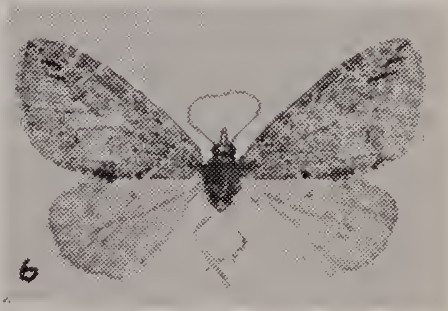
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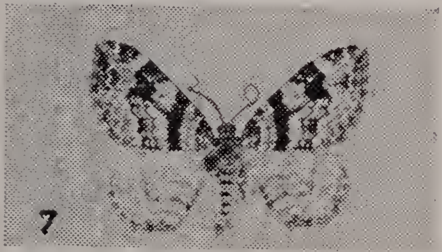
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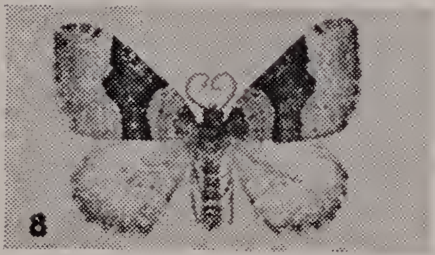
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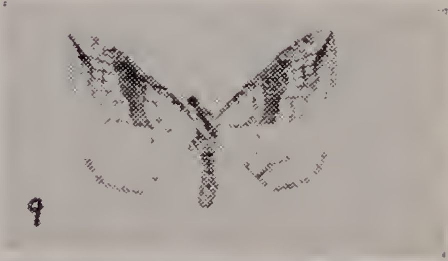
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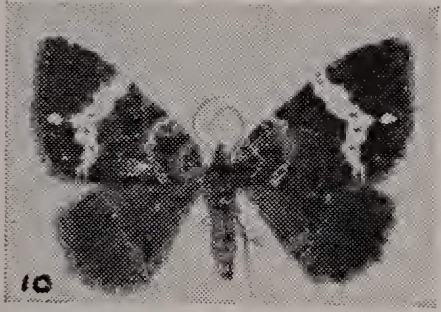
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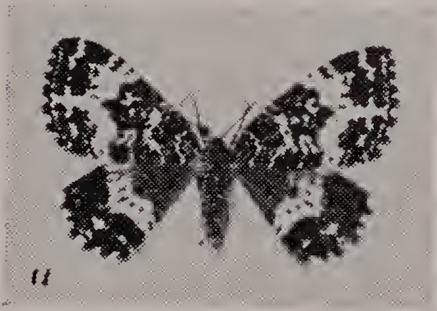
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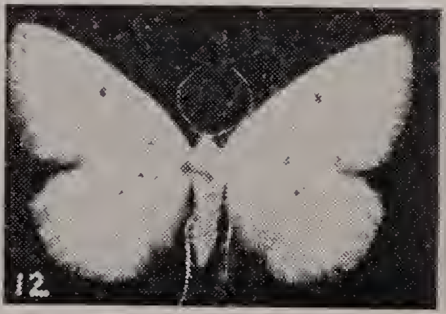
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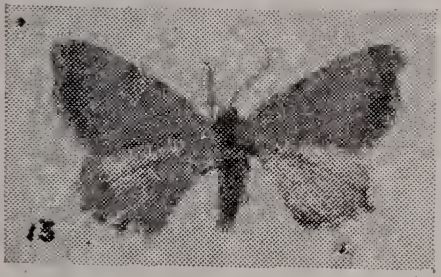
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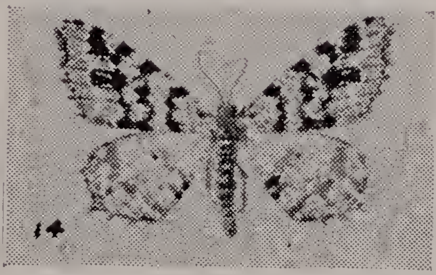
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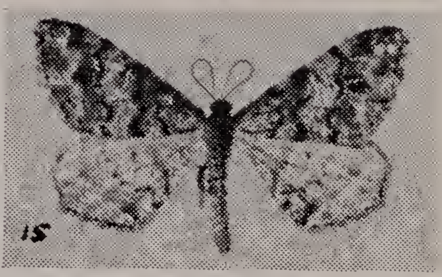
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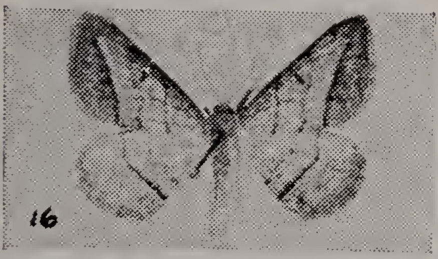
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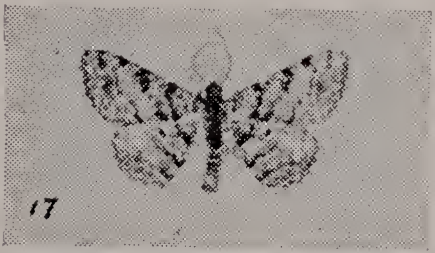
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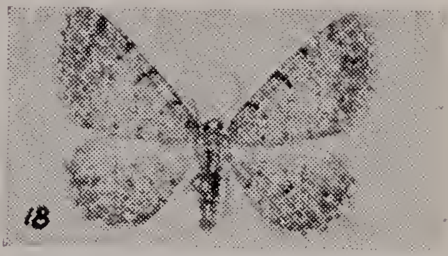
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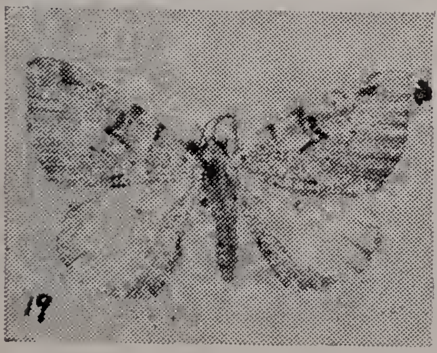
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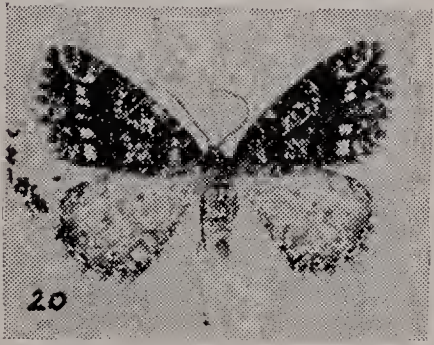
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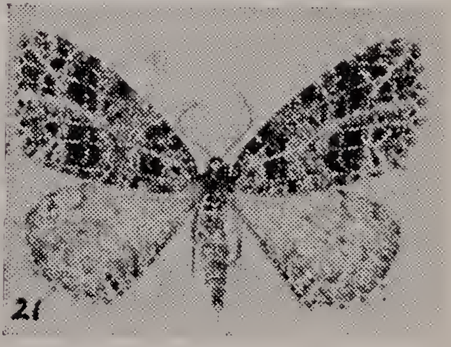
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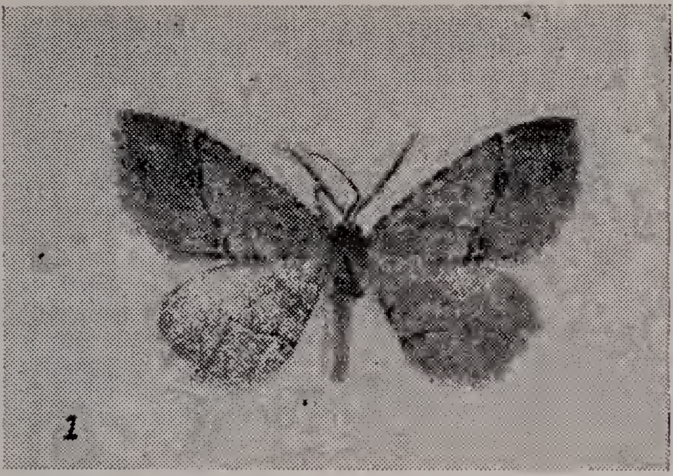
PLATE XVI

1. Melanolophia signataria Wlk. ♂. Topotypical. Caledonia, May 13, 1952.
2. Epirrhanthis substriataria Hlst. ♀. Centreville, May 9, 1950.
3. Eumacaria latiferrugata Wlk. ♀. Centreville, July 23, 1949.
4. Anavitrinella pampinaria erosiata Wlk. ♂. Mount Uniacke, June 22, 1951.
5. Anacamptodes humaria Gn. ♂. Mount Uniacke, June 7, 1950.
6. ,, vellivolata Hlst. ♂. Waverley, June 1, 1952.
7. Tacparia zalissaria Wlk. ♂. Coldbrook, June 5, 1949.
8. Hyperetis nepiasaria Wlk. ♂. Topotypical. Armdale, July 8, 1948.
9. Cepphis decoloraria Hlst. ♂. Armdale, July 1, 1948.
10. Plagodis kuetzingi Grt. ♂. Annapolis, June 13, 1949.
11. ,, phlogosaria iris Rupert, ♂ paratype. Armdale, June 23, 1947.
12. Cingilia canosaria Wlk. ♂. Topotypical. Lake Rossignol, August 24, 1951.
13. Metarranthis lateritiaria Gn. ♂. Annapolis, June 16, 1949.
14. ,, broweri Rupert ♂. Annapolis, June 11, 1949.
15. ,, franclemonti Rupert ♂. Port Wallis, June 10, 1952.
16. Anacamptodes ephyraria Wlk. Type, "Nova Scotia"
17. Caripeta angustiorata Wlk. ♂. Topotypical. Armdale, July 19, 1950.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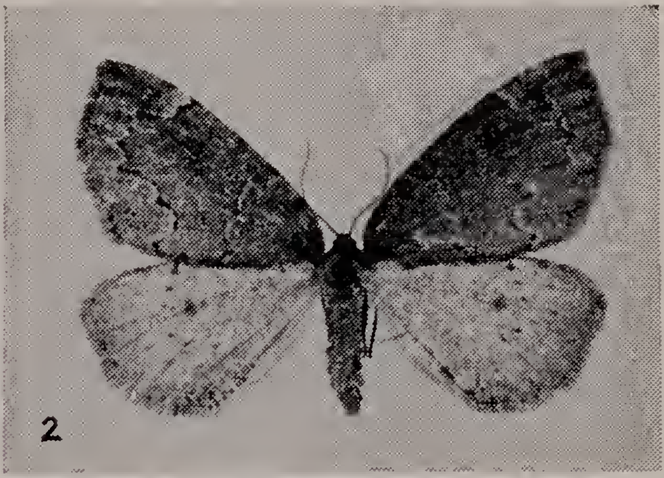
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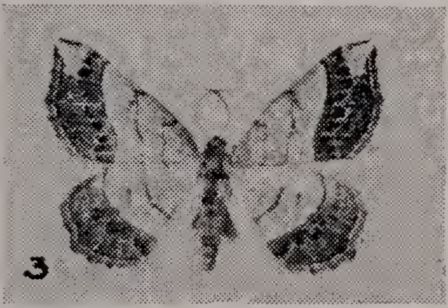
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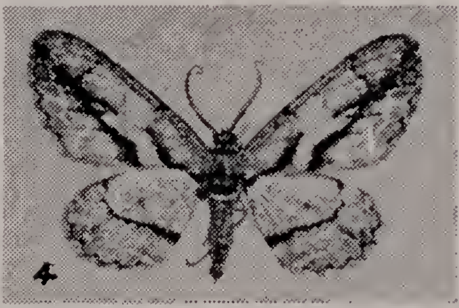
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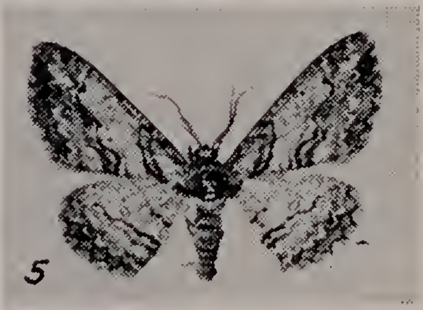
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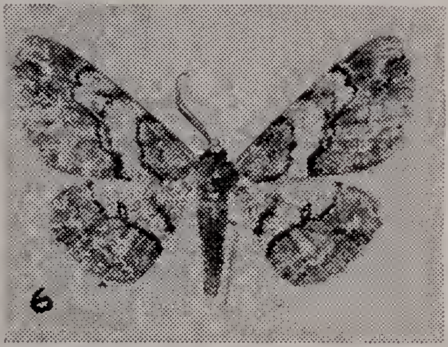
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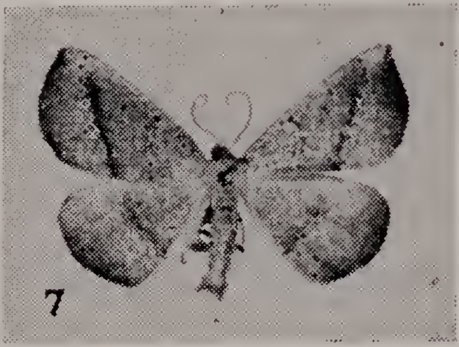
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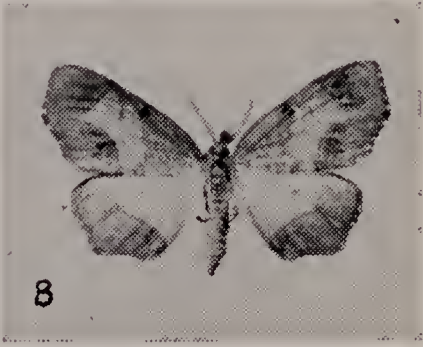
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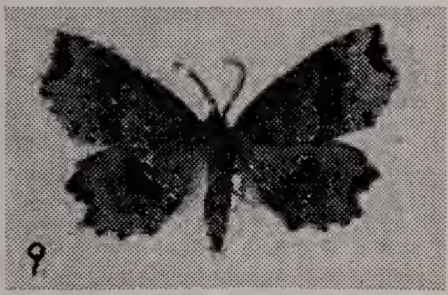
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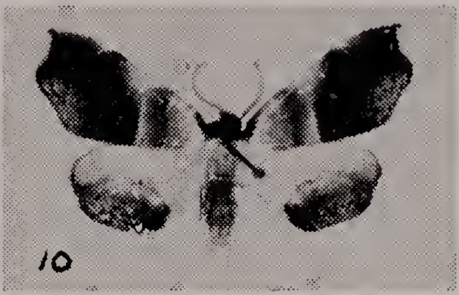
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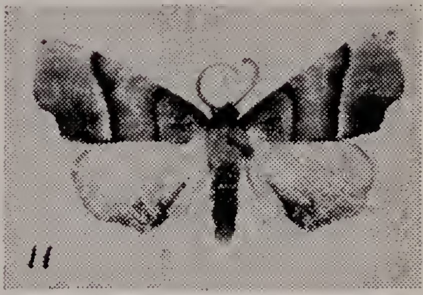
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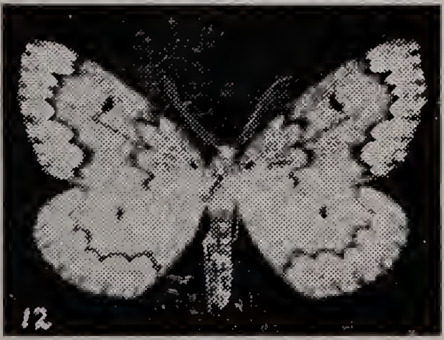
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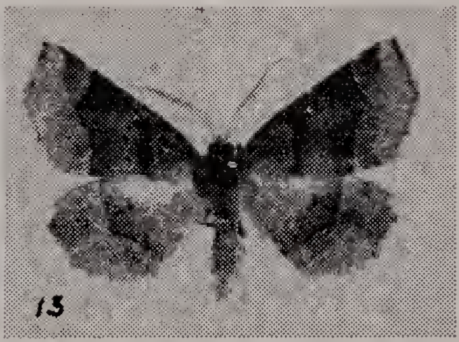
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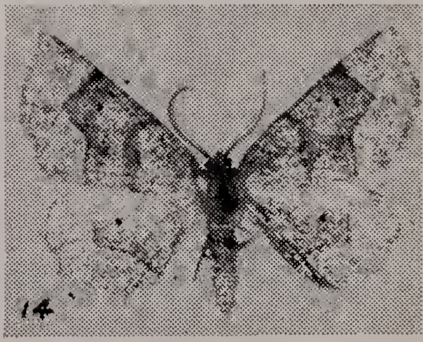
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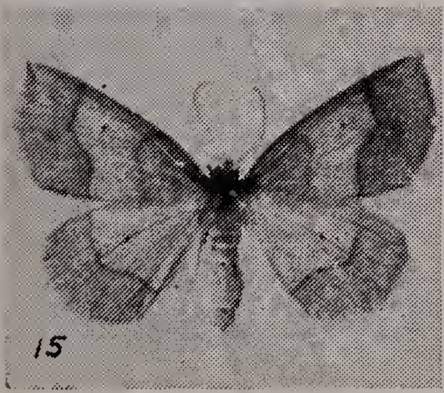
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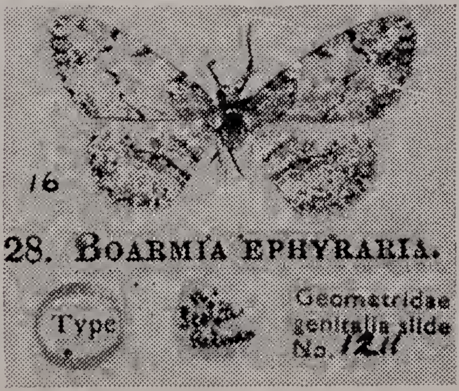
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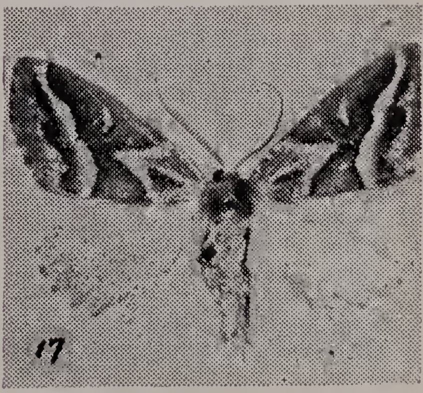
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REPORT OF RECORDING SECRETARY

Due to the absence through illness of the President, Dr. Alan Cameron, a report was given by the Recording Secretary, Dr. J. A. McCarter.

Deaths: Dr. L. C. Harlow, Truro, N. S. Dr. Harlow was elected Associate member 1905, Honorary 1947. Died January 16, 1952.

Membership: New members during the year 1951-52 were: Ordinary 29, Student 19, Associate 1. Two new Honorary members were elected during the year.

Total membership is now 273 of whom 108 are Ordinary members, 86 are Associate, 79 are Student. These figures include 3 Corresponding, 9 Honorary.

There are now 13 Life-Ordinary members.

Meetings: There was one business meeting, and there were 7 Ordinary meetings and 1 Extraordinary meeting. (Prof. Sci. G. I. Taylor). The Council held 8 meetings.

Attendance at the Ordinary meetings: Largest 71, Smallest 49, Average 58.

Papers: 21 papers were presented. These may be classed as Biological in nature 14, Physical 7. The papers originated from the following institutions and Departments. It is to be noted that two Associate members (from St. Andrews, N. B.) presented papers before the Institute.

Acadia and N. S. Museum of Science.........	1
Biology and Zoology, Dalhousie..............	3
Biochemistry, Dalhousie......................	1
Fisheries (Atlantic, Halifax).................	2
Fisheries (St. Andrews)......................	2
Naval Research Establishment...............	2
Pharmacology, Dalhousie.....................	1
Physics, Dalhousie...........................	2
Physiology, Dalhousie........................	4
N. S. Technical College......................	3
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PROCEEDINGS OF MEETINGS

Session of 1952-53

(Meetings were held in the Medical Sciences Building,
Dalhousie University, Halifax, N. S.)

91*st Annual Business Meeting, October* 20, 1952.

The meeting was presided over by the First-Vice-President, Dr. W. J. Chute. Because of illness, the President, Dr. A. E. Cameron was absent. Twenty members were present.

Reports of Officers were presented and are summarized as follows;

Recording Secretary's Report:

The death of Professor L. C. Harlow was noted to have occurred. The membership was 273, of whom 108 were Ordinary, 86 were Associate and 79 were Student members. There had been one business meeting, seven Ordinary meetings and one Extraordinary meeting during the course of the year. Council met nine times. The Ordinary meetings had been attended by an average of 58 persons with a range of 49 to 71. Twenty-one papers had been presented from ten Departments or Institutions.

Treasurer's Report:

Receipts	$ 913.94
Expenditures	196.27
Total assets, current account	1,470.74
Total assets, permanent fund	4,000.00

Corresponding Secretary's Report.

Several requests for back files of the Proceedings were received and six new exchanges were entered. The total number of exchanges was now 546. The index to the Proceedings was completed and in the hands of the Editor.

Editor's Report:

Part I of Volume 23 of the Proceedings was in preparation. One paper had been submitted for inclusion in Part 2 and the Index to the Proceedings from 1863 to 1950 had been received.

Librarian's Report:

Periodicals belonging to the Institute were now housed in the Library of the Nova Scotia Research Foundation. Additional sets of periodicals had been bound.

Officers elected for the year 1952-53 were:

President	Dr. W. J. Chute
First Vice-President	Dr. H. D. Smith
Second Vice-President	Dr. J. G. Aldous
Treasurer	Dr. J. R. Dingle
Corresponding Secretary	Dr. P. L. Hoogland
Recording Secretary	Dr. J. A. McCarter
Editor	Dr. H. R. Chipman
Librarian	Dr. R. Foran
Council	Dr. D. A. I. Goring, Mr. R. A. Hornstein, Dr. J. G. Kaplan, Dr. J. E. Keyston, Dr. A. D. MacDonald.
Auditors	Dr. H. L. Bronson and Dr. E. G. Young

The Secretary read the recommendations of Council regarding the establishment of a Branch of the Institute at Acadia University, Wolfville, N. S. These recommendations were adopted by the meeting.

1*st Ordinary Meeting*, November 10, 1952.

The following new members were announced (elected by Council, November 3, 1952.); Ordinary members, R. A. Lewin, Ph.D., Joyce Lewin, Ph.D., Wilfred Yaphe, Ph.D., W. W. Hawkins, Ph.D., W. H. Bowes, M.E., Gordon Retallack, Ph.D., L. B. MacPherson, Ph.D.; Student members, G. E. Cheney, B.Sc., G. D. Lutwick, B.Sc., S. M. Tancoo, B.Sc., G. M. Graham, B.Sc., R. J. McIntyre, B.Sc., J. H. Mathews, B.Sc., E. A. Ripley, D. K. Robinson, E. R. Semple, R. W. Tolmie, A. D. B. Woods and Miss Marion Collie.

Papers: "The Lipemia Clearing Factor Associated with Heparin" by C. B. Weld, Hazel Jones and Gordon Kaplan. "An Objective Aid for Forecasting Zero and Subzero Temperature for Halifax, N. S.," by R. E. Munn and D. G. Snow, "Determination of Carbon of Aqueous Solutions" by M. Civen and J. A. McCarter.

2nd Ordinary Meeting, December 8, 1952.

The following new members were announced (elected by Council December 8, 1952); Ordinary, H. C. Freeman, Miss A. Coffin and Dr. K. F. Gregory.

Papers: "An Instrument of the Solution of Simultaneous Equations", by W. H. Bowes, "The Response of Circulating Eosinophil Cells to Morphine and Related Substances" by J. C. Szerb, "Ultraviolet Irradiation of Ovalbumin Monolayers," by M. J. Fraser and J. G. Kaplan.

Extraordinary Meeting, December 17, 1952.

Mr. P. R. Crewe, Chief Hydrodynamist and Project Engineer of the aircraft firm of Saunders-Roe Ltd., Clowes, England, spoke on the subject "Some Aspects of Flying Boat Research and Development."

3rd Ordinary Meeting, January 12, 1953.

The following new members were announced (elected by Council on January 12, 1953); Ordinary, R. D. Tulloch, Student, Don P. McLeod, B.Sc.

Papers: "The Relativistic Schrodinger Equation" by W. J. Archibald, "Studies on the Metabolism of Procaine Hydrochloride in the Rabbit," by J. G. Aldous, A. S. Wenning and J. D. Levine, "Notes Towards the Estimation of Mortality, Total Population and Use Made of Atlantic Salmon," by F. R. Hayes.

4th Ordinary Meeting, February 9, 1953.

The following new members were announced (elected by Council on February 9, 1953); Ordinary, H. D. Oliver, M.D., H. S. Heaps, F. J. Moya.

Papers: 'An Application of Potential Theory to a Problem in Geophysical Exploration," by J. E. Blanchard and A. L. Carter, "The Allotropic Forms of Solid Iodine," by D. C. West, and "On the Nitrogenous Constituents of Fucus," by D. G. Smith and E. G. Young.

5th Ordinary Meeting, March 9, 1953.

The following new member was announced (elected by Council on March 9, 1953); Associate, John Perkins.

Papers: "The Infrared Spectrum of the Night Sky," by H. S. Heaps, "Adrenal Function in Pantothenic Acid Deficiency," by W. F. Perry, W. W. Hawkins and G. R. Cumming, "The Transformation of an Enzyme," by J. Gordin Kaplan.

6th Ordinary Meeting, April 13, 1953.

The following new members were announced (elected by Council on April 13, 1953); Ordinary, N. R. Goodman, Ph.D., and M. Evans.

Papers: "An Objective Method of Forecasting Maximum Temperatures Over Snow-covered Terrain," by J. D. Holland, "Velocity of Sound," by G. M. Graham, "Molecular Size and Shape of Carageenin," by D. A. I. Goring.

7th Ordinary Meeting, May 11, 1953.

The following new member was announced (elected by Council on May 11, 1953); Ordinary, R. L. deC. Saunders.

Papers: "The Flow of Nutrients Through the Thermocline in a Lake," by N. R. Beckett, "Effects of Pancreatic Extracts on Ketone-Body Metabolism in Liver Slices," by E. L. Roitman, "Measurement of C^{14} in Biological Material," by M. Civen and "Effects of Ultra-violet Light on Solutions of Ovalbumin," by M. J. Fraser.

VALLEY CHAPTER

The Valley Chapter of the Nova Scotian Institute of Science was organized at Wolfville on November 17, 1952. Scientists from the Annapolis Valley region had long felt the need for such an organization and through Dr. McCallion approached the Institute in Halifax regarding the formation of a local branch of the Institute. The conditions stipulated by the Iustitute were acceptable to the Annapolis Valley group and the Valley Chapter was organized.

Officers of the Chapter were elected as follows:

Dr. D. J. McCallion	President
Mr. J. F. Hockey	Vice-President
Mr. R. H. Magarvey	Secretary
Dr. F. H. Sexton	Treasurer
Miss Elizabeth MacMillan	Member of Council

The Thirty-five Charter members of the Chapter consisted of two life members, twenty-two ordinary members and eleven student members. A constitution was drawn up by the Council according to the conditions laid down by the parent body in Halifax. The members of the local Chapter enjoy the same rights and privileges as those of the Institute in Halifax.

Six ordinary meetings were held during the winter with one paper presented at each meeting. The titles of these papers with date of presentation is given below:

December 1, 1952—Tumours of the Amphibia, by D. J. McCallion.

January 5, 1953—Structural Geology of Nova Scotia, by H. L. Cameron.

February 2, 1953—Ecology of Sable Island, by John Erskine.

March 2, 1953—Fleshy Fungi of King's County, by K. A. Harrison.

April 13, 1953—The Geology of Cape D'Or, by M. Bancroft.

May 4, 1953—Fertility in Relation to Precipitation.

Determination of Carbon of Aqueous Solutions. M. Civen and J. A. McCarter. In biological tracer studies with radioactive carbon there is a need to measure the radioactivity of a sample of urine, or of a tissue of pure compounds in aqueous solution. This involves the conversion of the carbon of the sample quantitatively to carbon dioxide, thence to barium carbonate and the measurement of the radioactivity of the latter substance. There appears to be no single satisfactory method capable of oxidizing the carbon of such diverse materials in a quantitative manner.

The wet oxidizing agent that comes nearest to being a universal oxidant is, probably, the mixture of phosphoric, iodic, chromic and fuming sulphuric acids used by Van Slyke and Folch but this agent gives quantitative results only under nearly anhydrous conditions.

We have developed an apparatus that permits the distillation of water from the reaction mixture while the oxidation is proceeding. Using this apparatus and the Van Slyke Folch oxidizing agent we have been able to obtain quantitative results in the oxidation of a wide variety of compounds.

An Objective Aid for Forecasting Zero and Subzero Temperatures for Halifax, N. S. R. E. Munn and D. G. Snow. This is a study covering the last six winters of the cases when (a) an early morning minimum of zero or lower occurred at Halifax, and when (b) the forecast "Low Tonight" in the 11.15 a.m., AST. public forecast for Halifax was zero or lower.

The forecast accuracy is computed and found to be comparatively poor, indicating the need for some objective aid in dealing with these abnormalities. All cases when zero or lower did occur were examined for common features. Eight relevant factors were found. Next the thirteen forecast failures were examined, and it was found that not one of them satisfied all eight factors.

Ultraviolet Irradiation of Ovalbumin Monolayers. M. J. Fraser and J. G. Kaplan. A study of the ultraviolet irradiation of monolayers of the protein ovalbumin spread at the air/water interface shows the photochemical processes to be complex. All films were irradiated at constant surface pressure of 1 dyne/cm. on substrata of distilled water or M/15 saline, both buffered at the isoelectric point (pH—4.8 3-4.9). Control films were run simultaneously on an adjacent film balance. Measurements were made at room temperature (20° —24° C). During the first quarter-hour of irradiation, the areas of films spread on salt substratum increased by two per cent over the control films, while those spread on distilled water underwent no change. Thereafter the areas of the irradiated monolayers decreased at a remarkably regular rate. that for the films on saline being almost twice (-0.084—0.005 M^2./mg./hr.) that for films on distilled water (-0.046—0.005 M.^{2} /mg./hr.). The end result of the irradiation is a photochemical proteolysis yielding small, soluble, non-surface-active fragments, but initially a non-proteolytic structural alteration resulting in further unfolding of the already extended film molecules is seen to occur. As irradiation proceeds, the fiber-forming capacity is lessened, the fibers becoming shorter in length and more fragile; after two hours irradiation, no fiber can be obtained, though the area of the film before collapse is only approximately ten percent less than that of an unirradiated film.

The Response of Circulating Eosinophil Cells to Morphine and Related Substracts. J. C. Szerb. In order to investigate the possibility of adrenocorticoid hormones being released by narcotic drugs, the action of morphine, meperidine and codeine on the number of circulating eosinophil cells was determined. In mice 10 mg/kg of morphine caused a significantly greater drop in the number of eosinophils two hours after the injection than did 20 mg/kg of histamine. Adrenalectomy prevented the decrease following the injection of morphine and histamine. The comparison of the action of 10 mg/kg of morphine, 20 mg/kg of meperidine and 30 mg/kg of codeine showed the greatest decrease in the number of eosinophils after meperidine and the smallest after codeine. In humans 10 mg of morphine caused the largest about fifty per cent decrease in the circulating eosinophils followed by 50 mg. of meperidine and 30 mg of codeine. The maximal fall occurred two hours after the injection. The possible mechanism of the action of narcotic drugs on the pituitary-adrenocortical system is discussed.

AN INSTRUMENT FOR THE SOLUTION OF SIMULTANEOUS EQUATIONS. W. H. Bowes. The apparatus to be described is capable of solving simultaneous linear algebraic equations. It is a specialized instrument and hence is suitable for this mathematical process only and no other. The underlying principles are demonstrated by means of an instrument which solves two equations in two unknows, however, the principles are applicable to the solution of equations in many more unknows; the number being limited only by the degree of precision attained in constructing the instrument. By an iterative process the unknowns can be solved to any required degree of accuracy.

THE RELATIVISTIC SCHRODINGER EQUATION. W. J. Archibald. The Hamiltonian function provided by the theory of relativity is not wholly suitable as a foundation for quantum mechanics and in the present paper a new function will be derived which has the correct classical properties and which in addition satisfies some of the requirements of quantum mechanics. A few of the results which can be deduced from this revised Hamiltonian function will be presented.

STUDIES ON THE METABOLISM OF PROCAINE HYDROCHLORIDE IN THE RABBIT. J. G. Aldous, A. S. Wenning and J. D. Levine. Department of Pharmacology, Dalhousie University. The local anesthetic procaine hydrochloride is rapidly transformed in the living animal, following its intravenous administration, to diethylaminoethanol and p-aminobenzoic acid. The latter products are vitually devoid of toxic action but the intact procaine molecule is capable of producing generalized convulsions when administered in sufficient concentration.

NOTES TOWARDS THE ESTIMATION OF MORTALITY, TOTAL POPULATION AND USE OF ATLANTIC SALMON. F. R. Hayes. If a salmon population is stationary, two adults will survive from the 10,000 eggs of a spawning pair in a space of six years. In general, mortality is higher during early life than later. A theoretical mortality curve is set up in the form of a parabola. The curve is checked at several points by direct observations of survival during phases of river life, and is found to conform quite well to facts.

THE ALLOTROPIC FORMS OF SOLID IODINE. D. C. West. Solid iodine belongs to the class of molecular crystals, which are held together by Van der Waals forces. The ordinary orthorhombic form has been very thoroughly studied, but there has been some controversy over the existence and nature of other crystalline modifications. During the course of measurements of the energy distribution of the lattice electrons in solid iodine, a new low-temperature form of iodine was observed and evidence was obtained of a third form, metastable with respect to the orthorhombic. Reasons will be given for assigning an amorphous structure to the former and for considering that the latter is the monoclinic variety reported by some previous workers.

On the Nitrogenous Constituents of Fucus. D. G. Smith and E. U. Young. Maritime Regional Laboratory, N.R.C., Halifax, N. S. The content of total nitrogen in the Fucaceae varies from one to three per cent on the basis of dry weight. As high as twenty-five per cent of the total nitrogen may consist of dialyzable compounds of low molecular weight, such as volatile bases, free amino acids and peptides. Ammonia, methylamine, and trimethylamine together comprise two to three per cent and free amino acids eight to eleven per cent of the total nitrogen. The peptide fraction contains seven to eight per cent of the total nitrogen as isolated in the form of the crude mercury salt.

The amino nitrogen liberated by acid hydrolysis was determined both gasometrically and by formol titration. Results indicate approximately sixty per cent to be in the form of combined amino acids. Qualitative analysis by means of paper chromatography showed the latter to be present in the distribution usual in plant proteins, except for the absence of hydroxyproline. Chromatography on Nalcite HCR and starch has confirmed these results, and the combined amino acids have been determined quantitatively. The remaining fifteen per cent of the total nitrogen was lost as unhydrolyzed cellular residue or in the formation of the humin fraction.

The efficacy of various aqueous media in the extraction of nitrogenous compounds has been tried and the effect of protein precipitants on the solutions obtained has been determined. Sodium hydroxide was found to be the most effective solvent. Increase in the pH of the solvent increased the extraction of nitrogenous compounds and also of alginate and other materials. The character of the nitrogenous substances changed with higher extraction as judged by precipitability with tungstic acid. As more nitrogen was precipitated, it was associated with more alginate. Addition of hydrochloric acid to pH 4 or of tungstic acid to a concentration of two per cent gave maximum precipitation, equivalent to fifty per cent of the soluble nitrogen from a solution containing fifty per cent of the original plant nitrogen.

An Application of Potential Theory to a Problem in Geophysical Exploration. J. E. Blanchard and A. L. Carter. An expression for the potential distribution caused by a steady electric current originating from a point source near an infinite cylinder characterized by a resistivity p c in an infinite, homogenous medium characterized by a resistivity p m is given. The application of this solution to resistivity methods of geophysical exploration from underground mine workings is considered.

The Transformation of an Enzyme. J. Gordin Kaplan. Department of Physiology., Dalhousie University. In recent years, it has become increasingly common for biochemists to extrapolate to the living cell information acquired from the studies of enzymes in vitro. The reason for this is the biochemist's obsession to extract from the cell ever purer and more homogeneous proteins, crystalline wherever possible. The physiologist has long suspected that crystallinity in virto is no guarantee of biological identity, and that a biologically active protein may be quite different while in place within the living cell than after having undergone considerable treatment, tender as this may be, at the hands of his biochemical colleague. The present experiments have shown that the intracellular enzyme of yeast, catalase, undergoes a dramatic and specific change in biological properties after extraction from the cell; this phenomenon has been dubbed enzymatic transformation. The use of certain physical and chemical agents has permitted the transformation of this enzyme while it remains within the cell; the possibility of intracellular transformation has been used to rule out any alternative hypothesis not involving an intrinsic change in configuration of this enzyme, such as permeability of the cell etc. The conclusion is reached that it is not permissible to assume that an enzyme within the cell possesses either othe same absolute activity per molecule, or even the same qualitative characteristics of activity, as the very same enzyme molecule extracted from the cell.

ADRENAL FUNCTION IN PANTOTHENIC ACID DEFICIENCY. W. F. Perry, W. W. Hawkins and G. R. Cumming. Department of Physiology and Medical Research, University of Manitoba, Winnipeg. Structural and functional changes in the adrenal cortex have been described in animals deficient in pantothenic acid. The present investigation was designed to extend observations to the adrenal content of cholesterol and ascorbic acid in pantothenate deficiency in rats, since alterations in these have been observed under conditions of stress, involving primarily the adrenal cortex. This seemed of particular interest because it is known that acetate is a precursor of cholesterol, and that coenzyme A, a pantothenate derivative, is an important coenzyme in acetate metabolism.

Young rats weighing forty to fifty grams were maintained on a purified diet, and water-soluble vitamins were given daily by injection. Some received no pantothenic acid, and some received the same amount of it as the controls, but one tenth the amount of the other B vitamins.

In the pantothenate-deprived animals the concentration of cholestrol but not of ascorbic acid in the adrenals became reduced, whereas no differences developed in controls receiving adequate amounts of B vitamins, or in those receiving smaller amounts of them but with adequate pantothenate. When the animals were exposed to cold both deficient and controls lost adrenal ascorbic acid at the same rate.

The results emphasize the prominence of adrenal cholesterol changes in pantothenate deficiency in the rat.

THE INFRARED SPECTRUM OF THE NIGHT SKY. H. S. Heaps. The intensity distribution of the rotation-vibration spectrum of the OH molecule has been calculated with a view to establishing the mechanism leading to the intensities of the light observed in the night sky. It is found that the assumption of a certain initial energy level for all the molecules, and that each molecule radiates energy as a Morse oscillator, gives results in fair agreement with observation. It is necessary to calculate both linear and quadric moments, and for this an explicit formula has been derived.

AN OBJECTIVE METHOD OF FORECASTING MAXIMUM TEMPERATURES OVER SNOW-COVERED TERRAIN. J. D. Holland. The Washburn method of forecasting maximum temperatures is reviewed, and an adjustment to this method is given, permitting its use when the ground is covered with snow.

Washburn developed an empirical relationship between the amount of insolation reaching the earth's surface and the modification which must be made to the temperature curve on a pressure-temperature diagram in order to arrive at a reasonable forecast of the maximum temperature. The relationship derived made allowance for variation in the atmospheric water vapour content and the amount of cloud in the sky. A transparent slide was developed by Washburn and Powe, incorporating this relationship into a form in which it could be easily and quickly applied to a temperature-pressure diagram.

This procedure was developed, and tested during the summer months, and no allowance was made for the ground being covered with snow. The present paper demonstrates a method whereby the Washburn procedure can be adjusted for use in the case where the ground is snow-covered. Theoretical consideration of the albedoes of various earth surfaces, including snow, indicates that the maximum area of modification in the Washburn method should be reduced by approximately one-half for snow cover. This conclusion is supported by the results of experimental application carried out during the winters 1948-49 to 1951-52, inclusive. Two difficulties in applying the method were encountered, and these are discussed briefly.

VELOCITY OF SOUND. G. M. Graham, Department of Physics, Dalhousie University. The velocity of sound in water has been measured, using an approximation to exact boundary conditions for which the form of the radiation field is known in closed form. Measurements have been made at 7.6 mc. and .6 mc. to an accuracy of .01 per cent, and a dispension effect is indicated, of the order of the experimental error, over a temperature range of 10°-20°c. A description of apparatus is given.

MOLECULAR SIZE AND SHAPE OF CARAGEENIN. D. A. I. Goring, Maritime Regional Laboratory, National Research Council. Sodium carageenate was prepared by aqueous extraction and dialysis from Irish moss. A part o the sample was degraded by autoclaving for fifteen minutes at a steam pressure of 15 p.s.i. Determination of light scattering, viscosity and reducing power were done on the nrmal and degraded material.

On degradation, the intrinsic viscosity fell from 11.9 to 0.8 while the reducing power increased from 0.5 to 3.7 per cent expressed as galactose. From light scattering, the molecular weight of the normal material was 1,670,000 which decreased to 610,000 for the degraded polysaccharide. The angular distribution of intensity extrapolated to zero concentration fell between the theoretical curves for stiff rods and polydisperse coils.

A particle having a long flexible structure of several chains with shorter side branches was consistent with these results.

MEASUREMENT OF C^{14} IN BIOLOGICAL MATERIAL. M. Civen. A method has been developed for the determination of carbon of aqueous solutions, using the Van Slyke-Folch oxidizing agent (a mixture of chromic, iodic, sulfuric, and phosphoric acids). Because the Van Slyke-Folch reagent is efficient only under nearly anhydrous conditions, urine, tissues, and other water containing materials must have the water removed in order to effect quantitative combustion of the material. This method differs from previous carbon combustion methods in that preliminary dessication of the material to be combusted is not required as the apparatus employed allows the water to be distilled from the digestion mixture while the oxidation is proceeding.

EFFECT OF PANCREATIC EXTRACTS ON KETONE-BODY METABOLISM OF RAT LIVER SLICES. Ellen Roitman. By aqueous extraction of the pancreas, followed by other purification methods, several insulin-free pancreatic extracts were prepared. These caused hyperglycemia on intravenous injection into rabbits and, in the presence of crude anterior pituitary extract depressed the ketonebody production of liver slices from female rats.

EFFECT OF ULTRA-VIOLET RADIATION ON DILUTE SOLUTIONS OF OVALBUMIN. M. J. Fraser and J. G. Kaplan. The hypothesis was put before the Institute at its December meeting that the action of UV on mono-molecular films of Ovalbumin consisted of two distinct phases: (1) a non-preteolytic alteration of the structure of the molecule and (2) a proteolysis, (rupture of pipicde bonds), resulting in extensive molecular fragmentation. This hypothesis has been put to the test by examining the effect of UV on solutions of this same protein. Predictions made on the basis of this hypothesis, involving changes in solubility, surface properties, and titratable basebuilding groups (formal titrations), were in all cases substantiated by experimental test.

THE FLOW OF NUTRIENTS THROUGH THE THERMOCLINE IN A LAKE. N. R. Beckett. The effect of difusion pressure in producing a flow of salts through the thermocline is described. Diffusion pressure varies directly with the absolute temperature, so that when a thermocline is established a flow of salts into the colder water would be expected. This flow of salts into the hypolimnion was demonstrated in laboratory experiments and was observed in Lily Lake, N. S. The nature of the vertical salt distribution curves in the artificial systems are similar to those of lakes possessing a thermocline. The flow through the thermocline was traced in both directions.

ABSTRACTS OF PAPERS READ BEFORE THE VALLEY CHAPTER. THE FLESHY FUNGI OF KINGS COUNTY, NOVA SCOTIA. K. A. Harrison One hundred representative Kodachrome slides were shown of eighty-six larger fungi collected in Kings County. Examples of:

Myxomycetes (1); Tuberales (1); Pezizaceae (4); Helvellaceae (2); Geoglossaceae (2); Hypocreaceae (1); Tremellaceae (1); Thelephoraceae (1); Clavariaceae (2); Hydnaceae (3); Polyporaceae (4); Boletaceae (7); Agaricaceae (48); Hymenogastraceae (1); Sclerodermataceae (1); Nidulariaceae (2); Lycoperdaceae (4) Sclerodermataceae (1); Nidulariaceae (2); Lycoperdaceae (4); Phallaceae (1); were included.

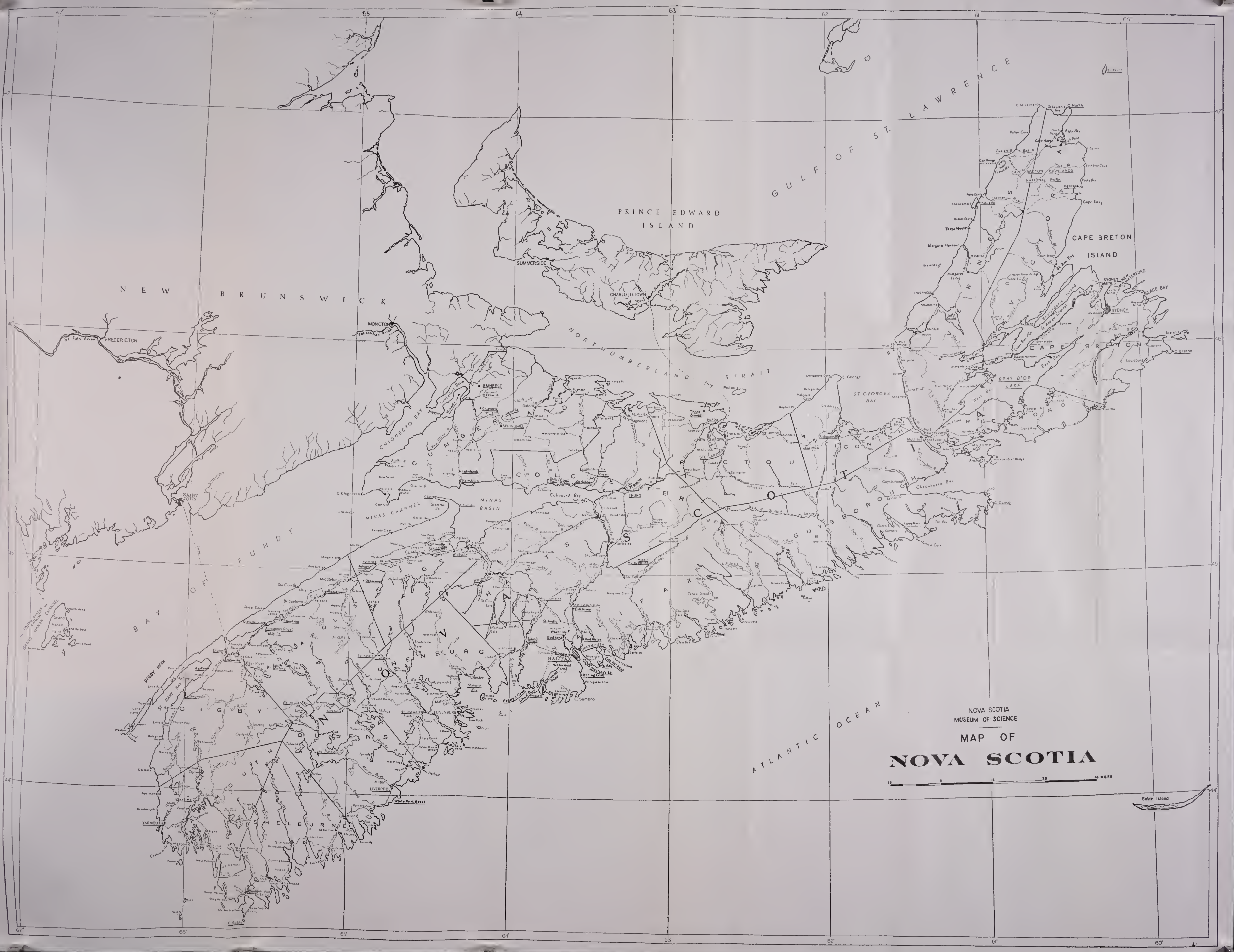
THE GEOLOGY OF CAPE D'OR, CUMBERLAND COUNTY. N. S. M. F. Bancroft. Native copper at Cape D'Or has attracted attention since the days of Indian and French exploration. The cliffs and caves of the cape furnish a key section of the Triassic basalts of the Bay of Fundy region and also to the formation of copper deposits where primary concentrations due to igneous and activity and deposits of secondary minerals due to former weathering intermingle. Study of the results of former diamond drilling and that carried on during the Summer of 1952 narrows the search for copper ore bodies at Cape D'Or to fissured and faulted zones and to former weathered belts of altered volcanics. The mineralization within the upper one hundred feet of the top of the thickest and lowest flow, known as the Cape Spencer, seems worthy of investigation. Blocks of massive ruby copper (cuprite) containing globs of native copper have been picked up as float in glacial drift about the top of the Spencer flow in a number of localities.

THE STRUCTURAL GEOLOGY OF NOVA SCOTIA AS ILLUSTRATED BY AERIAL PHOTOGRAPHS. H. L. Cameron. Nova Scotia is fortunate in having had the geology of the entire Province completed, at least in reconnaissance fashion. The structural geology is quite complicated, and in places, unique, in as much as complete structures are visible in aerial photographs. The best examples of such structures are found in the Meguma Series of slates and quartzites which have been folded into anticlines and synclines and later eroded to exposure the structures in section. The Carboniferous and post Carboniferous also show many structures, particularly folds and faults. In one case faulting has been detected under the sea at Lismore. These features were illustrated by aerial photographs of Liscomb Mills, Bedford, Cape George, Lismore, Margaree, Sydney and Little Narrows. A number of three dimensional pictures were shown illustrating aerial photographic interpretation methods, particularly for the determination of dips. It was emphasized that only the more striking illustrations had been shown and that many other features had been mapped from the photographs, which were either obscure or invisible on the ground.

TUMOURS IN THE AMPHIBA. David J. McCallion. A brief discussion of the various types of tumour found in frogs and salamanders. These appear to be of the types found in mammals but are relatively rare. A review of the literature with respect to attempts to induce neoplasia in the amphibia. The present study concerns the effects of the carcinogen, 2-acetylaminofluoene upon adult and larval frogs. This substance induces a variety of benign and malignant neoplasms in several species of animals. It is required in relatively small amounts and for short periods of time. In frog tadpoles this chemical inhibits growth and regeneration. It has definite effects upon the activity of the melanophores. The tadpoles develop lesions of the liver resembling those described in mammals resulting from the same treatment. It is not certain that these lesions are neoplastic, but they may be of the type that precede or accompany liver cell carcinoma. This substance proved to be highly toxic to adult frogs and few survived treatment. In the survivors, after six to eight weeks, lesions of the liver, including necrosis and cirrhosis, appeared. No distinct neoplasms were produced.

SABLE ISLAND, 1952. John Erskine. A description of Sable Island in 1952, with special attention to the flora. Lists of plants, native vascular, introduced vascular, mosses and lichens are given and compared to previous findings. Birds observed are recorded. Attention is given to erosion by wind and by sea, and the conclusion is reached that the gradual attrition of sand below sea-level, rather than wind and wave erosion, is reducing the size of the island. The theory is advanced that the island is, in its present condition, of post-Pleistocene age.

FERTILITY IN RELATION TO PRECIPITATION. F. A. Herman. The fertilizing value of rain and snow is a subject of interest especially where chemistry and agriculture are closely associated. Electrical storms are stated to increase the nitrate content of the air. Late snowfall in spring is spoken of as the poor man's fertilizer. In an investigation in process at Kentville an endeavor is being made to obtain this relative information as well as to investigate the problem of the upkeep of soil fertility through precipitation.



NOVA SCOTIA
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MAP OF
NOVA SCOTIA

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Editorial Board: H. L. Bronson, Dixie Pelluet and J. A. McCarter

Printed for the Institute by Rolph-Clark-Stone-Maritimes, Limited
Date of Publication: July, 1955.

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PROCEEDINGS
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VOL. XXIII - PART IV

A PRELIMINARY SURVEY OF THE LAND AND FRESHWATER GASTROPODA OF CAPE BRETON, NOVA SCOTIA, CANADA

Gordon K. MacMillan

(Received for Publication March 9th, 1954)

During the summer of 1950 I spent the month of August on a collecting trip throughout Cape Breton, gathering land and freshwater mollusca at eleven localities in three counties. This expedition had a twofold purpose: (1) to make a preliminary survey of the land and freshwater mollusca of Cape Breton Island, that portion of the Province of Nova Scotia that had practically been neglected conchologically, and (2) to study the effects of isolation upon speciation of the land and freshwater mollusca as Cape Breton Island has been separated from the mainland some 25,000 years ago by the flooding of the St. Lawrence Valley. The Strait of Canso, parting Cape Breton from the mainland of Nova Scotia, is one-quarter to one mile in width, creating thus quite a formidable barrier to the migration and distribution of a number of forms of animal life.

There may be a third objective resulting from this survey of the land and freshwater gastropoda of Cape Breton, that of tying up the results of this study with those obtained by Dr. S. T. Brooks with a similar project in Newfoundland.

From a cursory survey of the land and freshwater gastropoda obtained during the summer of 1950 it can be stated that the shells so far collected and studied have shown such a basic genetic strength as to have retained their specific identity with those forms now living in Europe and in other sections of North America north of Mexico. This is perhaps due to the great similarity in climate and vegetation with that of the northern part of the mainland of North America. It must be borne in mind that this is only a superficial conclusion drawn from the study of a few hundred specimens collected at only eleven localities. No conclusive evidence can definitely be drawn until a more thorough and extensive survey had been made, not only throughout Cape Breton itself, but also on Prince Edward Island, Anticosti Island, Magdalen Island, and some of the islands of the Atlantic, all separated from the mainland at practically the same period of time during the Pleistocene Epoch.

In the section of "The List of Species" nearly all of the species and varieties of shells enumerated have been collected by myself. Acknowledgements have been made in cases where other collectors gathered shells or where the information has been obtained from various museums in eastern Canada. Where there are duplicates of localities by other collectors and myself the initials GKM refer to myself. The initials after the localities at which shells have been found are those of the collectors and references to the following list will indicate their identity. These symbols are used throughout this paper.

O & W—MURIEL J. ORD and ANNE H. G. WATTS.
ROMZ—ROYAL ONTARIO MUSEUM OF ZOOLOGY.
HBB—HOPE B. BRIDGEFORD.

Before many species and varieties will be found 1, 2, or 3 asterisks, which have definite indications to the species and localities.

LIST OF SPECIES

Class GASTROPODA

Subclass PROSOBRANCHIATA

Order Mesogastropoda

Family Hydrobiidae

Amnicola limosa limosa (Say)

Baddeck, Victoria County, Lagoon and Town Reservoir.

Amnicola limosa porata (Say)

Sydney, Cape Breton County, Mill Dam Pond.

Amnicola lustrica Pils.

Baddeck, Victoria County, Lagoon.

Subclass PULMONATA

Order Basommatophora

Family Carychiidae

Carychium exile exile Lea

***Whycocomagh, Inverness County, fields, along Whycocomagh Brook. This species was very common under a log resting among the short grasses and weeds in a rather damp section of the field near the mouth of the brook. This constitutes not only a new record for Cape Breton but also for Nova Scotia.

Carychium exile canadense Clapp

Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.

Whycocomagh, Inverness County, fields, along Whycocomagh Brook. *C. e. canadense* was associated with *C. exile* at Whycocomagh. Its habitat at Baddeck Bay was in the layer of damp leaves in the swampy area of the woods.

Family Physidae

Physa gyrina Say

Baddeck, Victoria County, Town Reservoir and Widdow Lake, Baddeck Bay, Victoria County, Baddeck Bay Brook, Northwest Arm, Cape Breton County, Frenchvale Creek Sydney, Cape Breton County, Mill Dam Pond Whycocomagh, Inverness County, Whycocomagh Brook.

Physa heterostropha (Say)

Bayfield, Inverness County (HBB).
Glendale, Inverness County (HBB).
Judique, Inverness County (HBB).
Kingsville, Inverness County (HBB).
Margaree, Inverness County (HBB).
Whycocomagh, Inverness County, Whycocomagh Brook.

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*Indicates a new locality record for Cape Breton as that species has been found elsewhere throughout the Island but not at that particular locality.

**Indicates that this is a new addition to the fauna of Cape Breton although the species has been recorded from the mainland of Nova Scotia.

***Indicates that this species is new to both the fauna of Cape Breton and the mainland of Nova Scotia.

Family Lymnaeidae

Stagnicola catascopium (Say)

Chapel Bridge, Inverness County, Margaree River (ROMZ)

Stagnicola palustris (Mueller)

Baddeck, Victoria County, Lagoon and Town Reservoir.
Baddeck Bay, Victoria County, pools in swampy area, along Baddeck Bay Brook.
Glendale, Inverness County (HBB).
Kingsville, Inverness County (HBB).
Whycocomagh, Inverness County, Whycocomagh Brook.

Pseudosuccinea columella (Say)

Baddeck, Victoria County, Town Reservoir.
Sydney, Cape Breton County, Mill Dam Pond.

Fossaria modicella modicella (Say)

Baddeck, Victoria County, small pools in woods.

Fossaria modicella rustica (Lea)

Whycocomagh, Inverness County, Whycocomagh Brook

Fossaria obrussa (Say)

Baddeck, Victoria County, Town Reservoir.
Sydney, Cape Breton County, Mill Dam Pond.

Fossaria umbilicata (C.B. Ad.)

Baddeck, Victoria County, small pools in woods.
Northwest Arm, Cape Breton County, Frenchvale Creek

Family Planorbidae

Helisoma anceps (Menke)

Baddeck, Victoria County, Town Reservoir.
Scottsville, Inverness County, Southwest Margaree River (ROMZ).

Helisoma campanulatum (Say)

Scottsville, Inverness County, Gilles Creek (ROMZ).

Gyraulus hirsutus (Gould)

Baddeck, Victoria County, Town Reservoir and Widdow Lake.

Northwest Arm, Cape Breton County, small pools of Frenchvale Creek.

Family Ancylidae

Ferrissia parallela (Hald.)

Baddeck, Victoria County, Town Reservoir and Widdow Lake.

This species was found mainly attached to the underside of the lily pads near the shore of Town Reservoir; a few empty shells were also collected in the drift along the shore, or under the trash further inland that had once been covered by water.

Order Stylommatophora

Family Succineidae

Succinea aurea Lea

***Baddeck, Victoria County, shores of Lagoon and environs of Town Reservoir.

***Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.

Succinea avara (Say)

Baddeck, Victoria County, woods, along Lagoon; environs of Town Reservoir; Widdow Lake Valley.

Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.

Sydney, Cape Breton County, banks, along Mill Dam Pond.

Whycocomagh, Inverness County, swampy area, along Whycocomagh Brook.

Succinea decampi gouldi (Pilsbry)

Baddeck, Victoria County, shore of Lagoon; environs of Town Reservoir.

Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.

Succinea ovalis (Say)

Baddeck, Victoria County, shore of Lagoon.
Whycocomagh, Inverness County, swampy area, along Whycocomagh Brook.

Succinea verrilli Bland

***Baddeck, Victoria County, woods; Widdow Lake Valley; environs of Town Reservoir; shore of Lagoon.
***Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.
***Sydney, Cape Breton County, banks, along Mill Dam Pond.
***Whycocomagh, Inverness County, swampy area, along Whycocomagh Brook.

Family Cionellidae

Cionella lubrica (Mueller)

Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
Sydney, Cape Breton County, banks, along Mill Dam Pond; small, open deciduous woods.
Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Pupillidae

Vertigo gouldi gouldi (A. Binney)

***Baddeck, Victoria County, woods; environs of Town Reservoir.
***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

Vertigo gouldi paradoxa Sterki

***Baddeck, Victoria County, environs of Town Reservoir.

Vertigo modesta (Say)

***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Vertigo ovata (Say)

***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Vertigo ventricosa (Morse)

**Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

Vertigo pygmaea (Draparnaud)

**Baddeck, Victoria County, woods; environs of Town Reservoir.
**Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
**Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.

Vertigo nylanderi Sterki

***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

The various species and varieties of *Vertigo* were found in damp and shaded places. Occasionally they occurred on the underside of bark, logs, and trash, such as large pieces of cardboard or empty burlap sacks, in exposed places which were overgrown with medium grasses.

Gastrocopta pentodon (Say)

Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Valloniidae

Vallonia excentrica Sterki

**Baddeck, Victoria County, fields; environs of Town Reservoir; shore of Lagoon.
**Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
**Sydney, Cape Breton County, banks, along Mill Dam Pond.
**Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.

Vallonia pulchella (Mueller)

Sydney, Cape Breton County, small, open deciduous woods.

Zoogenetes harpa (Say)

Baddeck, Victoria County, woods; shore of Lagoon.

Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Zoogenetes harpa seems to prefer the shelter of matts of mosses where it is found more abundantly than in any other type of habitat.

Family Strobilopsidae

Strobilops aenea Pilsbry

***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

The chief habitation of this species, as with others of the genus, is under the loose or starting bark of logs.

Strobilops labyrinthica labyrinthica (Say)

***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

Strobilops labyrinthica virgo Pilsbry

***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Punctidae

Punctum minutissimum (Lea)

***Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.

***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

This species, very easily overlooked due to its extremely small size, can best be collected in the forest loam, the fine earth beneath logs and stones, and in the layers of damp leaves.

Family Helicodiscidae

Helicodiscus parallelus (Say)

**Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.

**Sydney, Cape Breton County, banks, along Mill Dam Pond; small, open deciduous woods.

Family Endodontidae

Discus cronkhitei crinkhitei (Newc.)

**Baddeck, Victoria County, woods; Widdow Lake Valley.
**Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
**Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
**Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.

Discus cronkhitei catskillensis (Pilsbry)

***Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
***Marble Mountain, Inverness County (HBB).
***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Anguispiridae

Anguispira alternata (Say)

***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Zonitidae

Retinella binneyana (Morse)

***Baddeck, Victoria County, environs of Town Reservoir.
***Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
***Leitche Creek, Cape Breton County, woods, along small branch of George River.
***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Retinella electrina (Gould)

Baddeck, Victoria County, woods; environs of Town Reservoir.

Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Oxychilus cellarius (Mueller)

Baddeck, Victoria County, woods.
Sydney, Cape Breton County, banks, along Mill Dam Pond; small, open deciduous woods.

Oxychilus draparnaudi (Beck)

***Baddeck, Victoria County, Widdow Lake Valley.
***Sydney, Cape Breton County, banks, along Mill Dam Pond.

These two species of *Oxychilus* seem to occur in situations not far from human habitations, probably having been imported with ornamental flowers and shrubs from Europe.

Striatura exigua (Stimp.)

**Baddeck, Victoria County, woods; Widdow Lake Valley.
**Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
**Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Striatura ferrea Morse

**Baddeck, Victoria County, woods.

Striatura milium (Morse)

***Baddeck, Victoria County, woods.
***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
***Sydney, Cape Breton County, small, open deciduous woods.
***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Zonitoides arboreus (Say)

Baddeck, Victoria County, woods; Widdow Lake Valley; shore of Lagoon; environs of Town Reservoir.

Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
Finlayson, Victoria County (HBB).
Ironville, Cape Breton County, small woods on embankment of CNR.
Leitche Creek, Cape Breton County, woods, along small branch of George River.
Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
Glendale, Inverness County (HBB).
Kingsville, Inverness County (HBB).
Malagawatch, Inverness County (HBB).
N. E. Margaree, Inverness County (HBB).
Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.

Zonitoides nitidus (Mueller)

Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.

Vitrina limpida Gould

***Baddeck, Victoria County, Widdow Lake Valley.
***Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
***Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
***Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Arionidae

Arion circumscriptus Johnston

**Baddeck, Victoria County, woods and fields (GKM)
**Boularderie Island, Victoria County (O&W).
**Glendale, Inverness County (O&W).
**Kingsville, Inverness County (O&W).
**Malagawatch, Inverness County (O&W)
**Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.
**East Bay, Cape Breton County (O&W).
**Louisburg, Cape Breton County (O&W).
**Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.

**Sydney, Cape Breton County, banks, along Mill Dam Pond; small, open deciduous woods.

Arion subfuscus (Drap.)

***Kingsville, Inverness County (O&W).
***Malagawatch, Inverness County (O&W).
***Port Hastings, Inverness County (O&W).
***Louisburg, Cape Breton County (O&W).
***Sydney, Cape Breton County, banks, along Mill Dam Pond.
***Sydney River, Cape Breton County (O&W).
***Port Hawkesbury, Richmond County (O&W).
**River Bourgeois, Richmond County (O&W).

Family Limacidae

Deroceras laevé (Mueller)

Baddeck, Victoria County, woods and fields.
Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
Big Harbour, Victoria County (O&W).
Finlayson, Victoria County (O&W).
Dunvegan, Inverness County (O&W).
Glencoe, Inverness County (O&W).
Glendale, Inverness County (O&W).
Judique, Inverness County (O&W).
Kingsville, Inverness County (O&W).
Malagawatch, Inverness County (O&W).
Marble Mountain, Inverness County (O&W).
Melford, Inverness County (O&W).
N. E. Margaree, Inverness County (O&W).
Whycocomagh, Inverness County, woods and fields, along Whycocomagh Brook.
Louisburg, Cape Breton County (O&W).
Northwest Arm, Cape Breton County, woods, along Frenchvale Creek.
Sydney, Cape Breton County, banks, along Mill Dam Pond; small, open deciduous woods.
Oban, Richmond County (O&W).

Deroceras reticulatum (Mueller)

***Baddeck, Victoria County, woods and fields (GKM) (O&W).

***Baddeck Bay, Victoria County, woods and swampy area, along Baddeck Bay Brook.
***Big Harbour, Victoria County (O&W).
***Boularderie Island, Victoria County (O&W).
***Finlayson, Victoria County (O&W).
***Big Pond, Cape Breton County (O&W).
***East Bay, Cape Breton County (O&W).
***Irish Cove, Cape Breton County (O&W).
***Louisburg, Cape Breton County (O&W).
***Sydney River, Cape Breton County (O&W).
***Dunvegan, Inverness County (O&W).
***Glencoe, Inverness County (O&W).
***Glendale, Inverness County (O&W).
***Judique, Inverness County (O&W).
***Kingsville, Inverness County (O&W).
***Long Point, Inverness County (O&W).
***Malagawatch, Inverness County (O&W).
***Marble Mountain, Inverness County (O&W).
***Melford, Inverness County (O&W).
***N. E. Margaree, Inverness County (O&W).
***Port Hastings, Inverness County (O&W).
***Whycocomagh, Inverness County (O&W).
***The Points, West Bay, Inverness County (O&W).
***Louisdale, Richmond County (O&W).
***Oban, Richmond County (O&W).
***Port Hawkesbury, Richmond County (O&W).
***River Bourgeois, Richmond County (O&W).
***Soldiers' Cove, Richmond County (O&W).

Family Kaliellidae

Euconulus fulvus (Mueller)

Baddeck, Victoria County, woods; Widdow Lake Valley.
Baddeck Bay, Victoria County, woods, along Baddeck Bay Brook.
Leitche Creek, Cape Breton County, woods, along small branch of George River.
Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Family Helicidae

Hygromia hispida (Linne)

**Baddeck, Victoria County, woods; shore of Lagoon.

**Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
**Sydney, Cape Breton County, bank, along Mill Dam Pond; small, open deciduous woods.
**Whycocomagh, Inverness County, fields, along Whycocomagh Brook.

Cepaea hortensis (Mueller)

Baddeck, Victoria County, woods; Widdow Lake Valley.
Baddeck Bay, Victoria County, woods and road embankment, along Baddeck Bay Brook.
Gillie Point. Victoria County (ROMZ).
Ironville, Cape Breton County, small woods, on embankment of CNR.
Sydney, Cape Breton County, small open deciduous woods.
Margaree Harbour, Inverness County (ROMZ).
Whycocomagh, Inverness County, woods, along Whycocomagh Brook.

Only two of the six sets of this species collected in Cape Breton during the summer of 1950 have banded specimens. Two specimens having these bands were found in the small woods on the embankment of the CNR at Ironville, Cape Breton County. The set from the woods, Baddeck, Victoria County, contains two banded individuals. These banded forms, 3-5 bands, are jouveniles, except one from Ironville, which is an adult. All the remaining specimens are of a yellow (primrose yellow to olive-yellow according to Dr. H. A. Pilsbry) color with a white lip. In the lots containing the uniform colored specimens the range is from jouveniles to adults.

The following charts show the distribution of the land snails collected by the author throughout the eleven localities in the three counties of Cape Breton.

In addition to the land and freshwater gastropoda collected during the summer of 1950 in Cape Breton Island there were a number of sets of *Sphaeriidae* (finger-nail clams). The species of these were identified by the Rev. H. B. Herrington, Keene, Ontario, to whom I am greatly indebted. The species are as follows:-

Pisidium casertanum (Poli)

Baddeck, Victoria County, small pools; Town Reservoir
Baddeck Bay, Victoria County, swampy area, along Baddeck Bay Brook.
Sydney, Cape Breton County, Mill Dam Pond.
Whycocomagh, Inverness County, swampy area, along Whycocomagh Brook.

Pisidium nitidum Jenyns

Baddeck, Victoria County, Widdow Lake

Sphaerium lacustre lacustre (Mueller)

Northwest Arm, Cape Breton County, pools, along Frenchvale Creek.

Sphaerium lacustre ryckholti (Norman)

Baddeck, Victoria County, Town Reservoir

I wish to express my appreciation to Dr. H. A. Pilsbry, Academy of Natural Sciences, Philadelphia, Pennsylvania, who was kind enough to verify the identification of a number of sets of shells sent him, and also for correcting the identity of some of the species and varieties that I had made.

	Sydney				Baddeck					
	Mill Dam Pond	Deciduous Woods	Leitche Creek	Northwest Arm	Woods and Fields	Widdow Lake	Town Reservoir	Lagoon	Baddeck Bay	Whycocomagh
Punctum minutissimum									X	X
Helicodiscus parallelus	X	X							X	
Discus cronkhitei				X	X	X			X	X
c. catskillensis									X	X
Anguispira alternata										X
Retinella electrina				X	X		X		X	X
binneyana			X				X		X	X
Oxychilus draparnaudi	X					X				
cellarius	X	X			X					
Striatura exigua					X	X	X		X	X
milium		X			X				X	X
ferrea					X					

	Sydney				Baddeck					
	Mill Dam Pond	Deciduous Woods	Leitche Creek	North-west Arm	Woods and Fields	Widdow Lake	Town Reservoir	Lagoon	Baddeck Bay	Whycocomagh
Zonitoides[1] *arboreus*			X	X	X	X		X	X	X
nitidus									X	
Vitrina limpida				X		X			X	X
Arion circumscriptus	X	X		X	X					X
subfuscus	X									
Deroceras laeve	X	X		X	X				X	X
reticulatum	X			X	X				X	X
Euconulus fulvus			X		X	X			X	X
Hygromia hispida	X	X			X			X	X	X
Cepaea hortensis[2]		X			X	X			X	X

1. collected also at Ironville.
2. found also at Ironville.

	Sydney			Baddeck					
	Mill Dam Pond	Deciduous Woods	North-west Arm	Woods and Fields	Widdow Lake	Town Reservoir	Lagoon	Baddeck Bay	Whycocomagh
Carychium *exile*									X
e. canadense								X	X
Succinea *verrilli*	X			X	X	X	X	X	X
avara	X			X	X	X	X	X	X
ovalis							X		X
decampi *gouldi*						X	X	X	
aurea						X	X	X	
Cionella *lubrica*	X	X	X					X	X
Vertigo *ventricosa*								X	
gouldi				X		X		X	X
g. paradoxa						X			
ovata									X
modesta									X
pygmaea				X		X		X	X
nylanderi								X	

	Sydney			Baddeck					
	Mill Dam Pond	Deciduous Woods	Northwest Arm	Woods and Fields	Widdow Lake	Town Reservoir	Lagoon	Baddeck Bay	Whycocomagh
Gastrocopta pentodon									X
Vallonia excentrica	X			X		X	X	X	X
pulchella		X							
Zoogenetes harpa				X			X	X	X
Strobilops aenea								X	
labyrinthica								X	
l. virgo									X

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PRESIDENTIAL ADDRESS

NOVA SCOTIAN INSTITUTE OF SCIENCE

W. J. CHUTE

92nd Annual Meeting. October 26th, 1953

The meeting of this evening marks the close of the ninety-first and the beginning of the ninety-second session of the Nova Scotian Institute of Science.

Our constitution dictates that the president shall make a report to the annual business meeting on the progress of the Institute as indicated by its membership and activities during the past twelve months.

It grieves me to report the passing of three of our members. Dr. E. Rodolphe Faribault died in July of this year at the age of 92. He had been among our oldest corresponding members. As senior geologist in the Geological Survey of Canada much of his work had been done in Nova Scotia. For many years he was a member of the Mining Society of Nova Scotia.

A second corresponding member, Dr. Douglas MacIntosh, died almost a year ago. He had been research professor of Chemistry at Dalhousie University from 1922-30 and at the time an ordinary member of the Institute. Leaving Halifax he became Director of Research at Shawinigan Chemicals, Shawinigan Falls, until his retirement.

Mr. F. C. Churchill, an associate member, died on February 11th. He had been a regular attendant at our meetings while in Halifax and continued his interest in the Institute after his removal to Sherbrooke, Quebec.

The most outstanding achievement of the past year was the organization of the Valley branch of the Institute at Wolfville on November 17th, 1952. Under the presidency of Dr. D. J. McCallion, six ordinary meetings were held with one paper being presented at each meeting. The thirty-five Charter members of the branch consist of two life members, twenty-two ordinary members, and eleven student members. The ordinary members of the Valley branch are Associate members of the parent Institute.

Our gains in membership may in part be attributed to the formation of the Valley branch. During the year 17 Ordinary members, 15 Associate members and 25 student members were elected. The membership now stands at 115 Ordinary, 77 Associate, 84 Student, 9 Honorary, and 4 Corresponding members. There seems to be no doubt that the total membership of 289 is the largest in our history.

In the past year we held one business meeting, seven ordinary meetings, and one extraordinary meeting. Eight Council meetings were convened. The average attendance at the ordinary meetings was 54 with extremes of 45 and 64.

Twenty-two papers were presented at the ordinary meetings. The distribution by subject or laboratory of origin were: Physiology—4, Biochemistry—3, Maritime Regional Laboratories—3, Physics—3, Pharmacology—2, Public Weather Office—2, Zoology—2, Nova Scotia Research Foundation—1, Department of Engineering, Dalhousie—1, and the Nova Scotia Technical College—1.

It may be noted that the large influx of papers which was visualized at the last business meeting did not materialize. Although your Council had no great difficulty in filling the programmes of the seven ordinary meetings, the quantity of papers available at any time did not allow much freedom in the arrangement of the content of the programmes.

In conclusion, I wish to express my appreciation of the interest shown by all members of Council in the affairs of the Institute. In particular, may I express the thanks of the Institute to our Recording Secretary who asks to be relieved of his duties. For several years Dr. McCarter has shared with the Editor, the Corresponding Secretary and the Treasurer the more arduous duties connected with the Institute.

PROCEEDINGS OF MEETINGS

Session of 1953-54.

(Meetings were held in the Medical Sciences Building
Dalhousie University, Halifax, N. S.)

92nd Annual Business Meeting, October 26, 1953.

The meeting was presided over by the President Dr. W. J. Chute. Twenty-five members were present.

The President addressed the institute. The address appears on page 409 of the Proceedings.

Reports of other officers were presented and are summarized as follows:

Treasurer's Report:

Receipts	$ 921.30
Expenditures	1,608.94
Total assets, current account	785.82
Total assets, permanent fund	4,000.00

Corresponding Secretary's Report: During the past year there was a large number of requests for back numbers of the Proceedings. Back numbers prior to Volume IX were now out of stock. Volume XXII, Part 1, and the Cumulative Index had been mailed.

Editor's Report: Volume XXIII and the Cumulative Index had been published and distributed. Part 2 was now in the gallery stage. This was a large number and publication was expected sometime in 1954.

Officers elected for the year were:

President	Dr. W. J. Chute
First Vice-President	Dr. H. D. Smith
Second Vice-President	Dr. J. G. Aldous
Recording Secretary	Dr. A. D. MacDonald
Corresponding Secretary	Dr. P. L. Hoogland
Treasurer	Dr. J. R. Dingle
Editor	Dr. H. R. Chipman
Librarian	Dr. L. B. Macpherson
Council	Dr. J. G. Kaplan, Dr. J. Keyston, Mr. R. A. Hornstein, Dr. R. Reed, and Dr. D. A. I. Goring.
Auditor	Dr. H. L. Bronson

1st Ordinary Meeting, November 16, 1953.

The following new members were announced (elected by Council. November 2nd, 1953). Ordinary: Ian MacLean, M.A., D. Simpson, B.A. Sc., William Bridgeo, Ph.D. Student: Verna Cornick, Byran Reid, Maxine Holder, Robert Agnew.

Papers: 1. "The Interpretation of the Tuberculin Test" by C. B. Stewart; 2. "The Relation of Protein to the Chylomicron" by C. B. Weld; 3. "An Epidemic of Acute Nephritis", by R. W. Reed.

Extraordinary Meeting, December 3, 1953.

Dr. C. H. Mortimer, hydrologist for the Freshwater Biological Association in Lake Windermere, spoke on "Hydrobiological Research in Britain."

2nd Ordinary Meeting, December 14, 1953.

The following new members were announced (elected by Council December 14, 1953). Ordinary: J. M. Neelin, Nicholas Nementhy, R. P. Chapman, C. R. Mann, F. A. A. Fergusson, S. Barton, A. F. MacMillan. Students: Joan F. B. Cahill, D. P. MacLeod, Y. K. Paik.

Papers: "Evidence for the Role of Reduced Sulphur Compounds in Silicon Utilization by Diatoms", by Joyce Lewin; 2. "An Appraisal of Canadian Nutriture", by E. Gordon Young; 3. "Some Local Temperature Variations in Halifax", by Reid V. Dexter; 4. "Dikaryons in *Chlamydomonas moewusii*", by Ralph A. Lewin.

3rd Ordinary meeting, January 11, 1954.

The following new members were announced (elected by Council January 11, 1954); Ordinary: D. L. Vincent; Student: H. Bradford, J. D. Lynch, D. Santry.

Papers: 1. "Viscosity and Molecular Weight of Degraded Carageenin", by C. R. Masson and C. W. Caines; 2. "The Variation of Haemoglobin Level with Age and Sex," by W. W. Hawkins, E. Speck and Verna G. Leonard; 3. "Experimental Nephritis Due to Type Specific Streptococci" by R. W. Reed and B. H. Matheson.

4th Ordinary Meeting, February 8, 1954.

The following new members were announced (elected by Council February 8, 1954). Ordinary: E. B. Vaisey, W. R. C. Tupper.

Papers: 1. "Effects of Visible Radiation on the Ovotestes of the Slug, *Dercoeras Reticulatum*" by D. Pelluet and N. E. Henderson; 2. "Diffraction of an Acoustical Wave Obliquely Incident on a Plane Obstacle" by H. S. Heaps; 3. "Expansion of Monomolecular Films of Protein", by J. G. Kaplan and M. J. Fraser.

Extraordinary Meeting, February 22, 1954.

Dr. D. Roy Cameron, O.B.E., formerly Dominion Forester and recently connected with the Food and Agricultural Organization of the United Nations in Europe, spoke on "Post-War Development of Forestry in Europe."

5th Ordinary Meeting, March 8, 1954.

Papers: 1. "Fundamental Particles in the Cosmic Radiation", by J. G. Retallack; 2. "Purification of Lecithin", by L. B. MacPherson.

6th Ordinary Meeting, April 12, 1954.

Papers: 1. "Organo-Analytical Reagents—Aromatic Hydroxylamines", by G. S. Lutwick and D. E. Ryan; 2. "The Gel Strength and Optical Activity of Carageenin", by D. A. I. Goring; 3. "Slide Culture of Tubercle Bacilli", by R. W. Reed.

7th Ordinary Meeting, May 3, 1954.

Papers: 1. "Age Determination of a Submerged Tree Stump by Carbon 14 Analysis", by A. L. Carter; 2. "Position Annihilation in Metals", by R. E. Green and A. T. Stewart; 3. "A Kinetic and Thermodynamic Study of Intracellular Yeast Catalase", by M. J. Fraser.

Extraordinary Meeting, May 25, 1954.

Dr. J. H. Schulman of the Ernest Oppenheimer Laboratory, Cambridge, addressed the Institution on "Molecular Interactions and Associations at Solid/Liquid Interfaces with Special Reference to Flotation."

VALLEY CHAPTER

During the year 1953-54, the Valley Chapter of the Nova Scotian Institute of Science held a total of six meetings, usually on the first Monday of the months from November to April, and a total of seven papers were presented to the Chapter. At the annual business meeting for 1953-54, the following officers were elected:

President	Dr. J. F. Hockey
Vice-President	Prof. M. F. Bancroft
Secretary	Miss Joan McGowan
Treasurer	Dr. F. H. Sexton
Council Member	Miss E. MacMillan

Membership consisted of twenty-five ordinary members, one honorary and one life member, and one student member. L. E. Aalders, a former student member, became an ordinary member, and new members included C. A. Eaves, W. A. Draper, Mrs. J. S. Erskine, Miss L. J. McGowan, Dr. I. V. Hall, and Mrs. I. V. Hall.

The titles of the papers presented are as follows:

"Use of Taste Panels in Variety Testing", by G. W. Hope.

"Further Observations on the Fleshy Fungi of Kings County", by K. A. Harrison.

"The Ecology of St. Paul Island", by J. S. Erskine.

"Manganese Occurrences in Nova Scotia", by M. F. Bancroft.

"Plant Succession after Cutting and Burning of a Woodlot", by I. V. Hall.

"Deeply Weathered Granite in Nova Scotia," by R. H. MacNeill.

"Hormones in Horticulture", by C. A. Eaves.

On November 1st, 1954, the annual business meeting was held, at which the following officers were elected for 1954-55:

President	Prof. M. F. Bancroft.
Vice-President	Dr. C. J. Bishop
Secretary	Miss L. Joan McGowan
Treasurer	Harold T. Stultz
Council Member	Dr. D. J. McCallion

The reports of the retiring President and Treasurer are enclosed. Following the business meeting, Dr. D. J. McCallion addressed the group on the organization and history of the Hubrecht Embryological Laboratories, where he has spent some months as a member of an International Research group.

VALLEY CHAPTER

Presidential Address

J. F. Hockey

Ladies and Gentlemen:

It is a pleasure to welcome you to the second annual meeting of the Valley Chapter of the Nova Scotian Institute of Science.

During the past year we have had the privilege of enjoying the seven contributions of members engaged in biological or geological investigations. The papers were well received and discussed. Abstracts have been forwarded by the Secretary to the Institute office in Halifax.

The Treasurer's report will show the nature of our financial stability.

Your Council at a May meeting reviewed the sessions of the past year and suggested that some recommendations might be passed to the incoming Council and members.

1. Consideration be given to the presentation of papers of a review nature, summarizing recent work in a specialized field.

2. Critiques of some outstanding scientific papers would make interesting subjects.

3. Acceptable short papers could be presented on special techniques, short term projects, or such material as is frequently found published as "notes" or "brief articles" in some of our scientific journals.

The Council fully appreciates the apparent competition that prevails between our Institute and the Seminar groups both at Acadia and at Kentville. However, we feel that there is plenty of room for both, provided encouragement is given to authors to present his or her paper to the most appropriate audience. The experience gained in the presentation of a paper on one's work stimulates the self-confidence of the worker. We hope that more papers will be forthcoming from our members during the next year.

Please accept my sincere thanks for the honor and privilege of serving as President of this chapter for the past year. The wholehearted co-operation of the officers and members has made the holding of this office a pleasant and profitable experience.

VALLEY CHAPTER

Report of the Treasurer for the year 1953-54.

Receipts

Annual dues of 25 ordinary members	$	50.00
Annual dues of 1 student member		1.00
Bank Interest		.46
	$	51.46

Expenditures

Remittance of one half dues to N. S. Institute of Science	25.50
Miss Joan McGowan, postage, supplies, etc.	5.00
	30.50

Total Receipts	$	51.46
Total expenditures		30.50
Bank balance from 1952-53		59.52
Bank balance, Royal Bank of Canada		80.48

(Papers read before the Institute but not published in the Proceedings.)

INTERPRETATION OF THE TUBERCULIN TEST. C. B. STEWART. (Read November 16, 1953). A brief review was given of the method of preparation of tuberculin and the methods of administration of the tuberculin test. Data were presented on the tuberculin rections of 1292 students in the Halifax schools of nursing who were in training between 1947 and 1953.

The proportion of reactors to the Vollmer Patch test of ten tuberculin units accurately reflected the infection rate in the Nova Scotia population. There was a slight downward trend in the proportion of reactors from 1947 to 1953 paralleling a decrease in this disease throughout the province. There was also a definite increase in the proportion of reactors with age. On the other hand, the stronger test of 250 tuberculin units (2nd strength purified protein derivative of tuberculin) showed wide and apparently erratic fluctuations from year to year in the proportion of reactors and was not correlated with increasing age.

It was also demonstrated that positive reactions to the dose of ten tuberculin units was very stable, with only 0.5 per cent reverting to negative each year during a four year follow up. On the other hand 23.3% of the reactors to 250 tuberculin units were negative one year later. The incidence of tuberculosis was also higher among reactors to 250 tuberculin units than among the reactors to ten tuberculin units.

It was concluded that a high dose tuberculin test such as second strength purified protein derivative produces a large proportion of nonspecific reactions and should not be used as an index of a previous tuberculous infection.

THE RELATION OF PROTEIN TO THE CHYLOMICRON. C. B. WELD. (Read November 16, 1953) The lipid component of the chylomicron of an alimentary lipemia has been reported by various authors to be chiefly neutral fat. However, electrophoresis and ultracentrifuge studies place the chylomicrons in a lipoprotein fraction, and I have previously reported evidence indicating that the chylomicron must have a protein moiety. This has been studied with the following results.

By overlaying a lipemic serum with saline (pH 7.4) and centrifuging at 8,000-10,000 RPM a relatively pure suspension of chylomicrons is obtained. If this is now removed, made up with saline to the original volume, and centrifuged at 10,000 RPM the chylomicrons rise to form an opaque zone with a clear subnatant fluid. With care, the chylomicron layer can be pipetted off and transferred to a fresh volume of saline. It was hoped that after several such washings the protein of the suspending fluid would be completely removed, leaving only that protein that was bound as lipo-protein in the chylomicron.

It is found that, after 3 washings, the lipid content of the chylomicron layer has only been cut in half while the protein content has been reduced to about 2% of its former value. After four washings there is danger of the chylomicrons coalescing and forming a pellicle and thus being no longer chylomicrons. At this unstable period the chylomicron layer usually has a protein content of less than 0.002% and the proportion of protein to lipid is about 1% or less.

It is therefore concluded that in a lipemia the chylomicrons consist of lipid globules kept dispersed by an interfacial protein film of molecular dimensions and that very little protein, if any, is bound to the lipid as a lipo-protein complex.

AN EPIDEMIC OF ACUTE NEPHRITIS R. W. REED. (Read November 16, 1953.) Twenty-two cases of acute nephritis occurred in a localized rural area of Nova Scotia between October 1951 and January 1952. School attendance records and family illness surveys for this period showed a high absentee rate and a high incidence of acute sore throat Throat swabs from a large group of individuals were cultured and antistreptolysin titrations done on as many cases and contacts as possible. An unusually high carrier rate of type 12 hemolytic streptococci was revealed.

The laboratory and clinical findings in this epidemic are reported and discussed.

DIKARYONS IN CHLAMYDOMONAS MOEWUSII. RALPH A. LEWIN. (Read December 14, 1953.) *Chlamydomonas moewusii* is heterothallic but isogamous. Pairing gametes become associated first by their flagella, and then by a protoplasmic bridge between the papillae. Vis-a-vis pairs normally are actively motile for some hours: they remain in this stage for days if kept in darkness, since light appears essential for plasmogamy. The *plus* partner is solely responsible for the propulsion of the pair. Pairs in which the *plus* cell is genetically paralyzed are always initially immotile; whereas, in pairs between wild-type *plus* and paralyzed *minus* cells, motility is normal.

Certain U-V induced mutants have been found in which paralyzed *plus* gametes, mated with *minus* cells of wild-type or of different mutant stocks, recover motility after two to forty-eight hours (depending on the strain tested); and it can be shown by the use of markers that this is due to recovery of motility by the *plus* gamete. It is therefore concluded that, in these morphologically normal mutants, paralysis is a consequence of a genetic deficiency in certain as yet unidentified motility factors, which can be transmitted from one gamete to another. Since filtrates of wild-type cells do not induce recovery of paralyzed cells, transmission apparently takes place through the protoplasmic bridge. In this way, two nuclei of dissimilar genotype are capable of interacting within a single protoplasmic continuum, as in fungal heterokaryons, and suitable combinations are capable of producing phenocopies of wild-type.

There is no indication that the postulated motility factors are self-reduplicating: hybrid zygospores (mutant x wild type) segregate normally 2:2. In the case of one mutant, the paralysis gene is very closely linked with mating-type, no recombination having been obtained from over fifty zygotes analyzed.

SOME LOCAL TEMPERATURE VARIATIONS IN HALIFAX. REID V. DEXTER. (Read December 19, 1953.) A comparison of daily maximum temperatures at 14 Mayfield Avenue. with the official downtown maxima is presented for the months of May, June, July, August and September, 1953. Differences as high as 11°F. are shown. Conditions of wind and sunshine conducive to large differences are pointed out, but it is shown that no ready rule of thumb can be evolved to make possible the computation of the Mayfield Avenue temperature from the downtown temperature and the general meteorological conditions.

The results of daytime temperature measurements made during four trips around the city in an automobile equipped with a portable thermometer are tabulated. Temperature variations from one part of the city to another at approximately the same time are as high as 14°F.

These variations are related qualitatively to the wind and the topography of the city.

AN APPRAISAL OF CANADIAN NUTRITURE. E. GORDON YOUNG. (Read December 14, 1953.) From a review of data available at present it may be concluded that Canadians have available adequate quantities of all essential nutrients if consumed according to individual requirements. School children across the country show an appreciable percentage who are underweight and exhibit sgns of past and present deficiences of vitamin D and calcium, and possibly of riboflavin. Local groups of adults show general undernutrition and deficiencies of vitamins A, B_2, C and niacin. Local groups of both children and adults are not eating a well balanced diet. A condition of mild anemia occurs in school children between the ages of five and fourteen years to the extent of probably less than five percent in most localities surveyed but that in certain sections of the country it may be much higher. This state of affairs also applies to about five per cent of young women in certain areas. Overweight in adults probably represents the commonest form of malnutrition and may be applicable to one fifth of the population over thirty years of age.

EVIDENCE FOR THE ROLE OF REDUCED SULPHUR COMPOUNDS IN SILICON UTILIZATION BY DIATOMS. JOYCE LEWIN. (Read December 14, 1953.) 1. Cells of the freshwater diatom *Navicula pelliculosa* may be grown in a mineral medium containing a low concentration of silicon. When transferred to a fresh silicate solution and incubated under non-growing conditions such depleted cells rapidly take up silicon from the medium.

2. The utilization of silicon is an aerobic process.

3. When depleted cells are washed with distilled water or saline, their ability to utilize silicon is impaired whereas respiration is unaffected.

4. The ability of washed cells to take up silicon can be partially restored with sulfate or ascorbic acid, and is completely restored by Na_2S, $Na_2S_2O_3$, glutathione, 1-cysteine, dl-methionine, or ascorbic acid plus sulfate.

5. The sulfhydryl reagent, $CdCl_2$, inhibits silicon utilization of unwashed cells at concentrations which do not affect respiration. This inhibition similarly is reversed by glutathione or systeine.

6. However, sodium iodoacetate and sodium arsenite inhibit respiration and silicon utilization at the same concentrations.

7. Sulfhydryl groups in the cell membrane may be involved in silicon uptake by diatoms.

EXPERIMENTAL NEPHRITIS DUE TO TYPE SPECIFIC STREPTOCOCCI. R. W. REED AND B. H. MATHESON. (Read January 11, 1954.) Several strains of type 12 streptococci recovered from throat cultures in widely separated outbreaks of acute glomerulonephritis have been used in these studies. Localized infection of rabbits with these strains has resulted in the appearance of hypertension, albuminuria and hematuria eighteen days following infection. Intravenous injection of filtrate from these cultures results in a similar picture eight days after the beginning of treatment. Animals infected locally with other serological types of streptococci and with unrelated bacteria did not develop hypertension or urinary abnormalities. The significance of the clinical and pathological findings and their relation to acute glomerulonephritis in man is discussed.

VISCOSITY AND MOLECULAR WEIGHT OF DEGRADED CARRAGEENIN. C. R. MASSON AND G. W. CAINES. (Read January 11, 1954.) Viscosities of aqueous solutions of carrageenin, including thermally and photochemically degraded preparations, have been measured both in the presence and absence of added salts. Measurements were made using Ostwald and Stormer viscometers. Number-average molecular weights were determined osmotically.

The viscosity characteristics of these solutions are entirely similar to those of other natural and synthetic polyelectrolytes. In the absence of salts, the viscosity-concentration relationship may be expressed by the Fuoss equation. The results are interpreted in terms of the shape of the carrageenin molecule in solution.

The relationship between viscosity and molecular weight indicates that the molecules exist in solution as fairly rigid rods, even in the presence of salts.

VARIATION OF THE HAEMOGLOBIN LEVEL WITH AGE AND SEX. W. W. HAWKINS, E. SPECK and VERNA G. LEONARD. (Read January 11, 1954.) During the winter and spring of 1952-53 a survey of haemoglobin values was made in Halifax among 1308 male subjects 6 to 98 years of age, and 1424 female subjects 6 to 94 years of age.

Capillary blood was used. Pigment was determined by converting to cyanmethaemoglobin and reading the optical density in a Coleman spectrophotometer. This method was standardized against blood of which the haemoglobin concentration had been determined from the iron content and oxygen capacity.

Among children 6 to 14 years old the values increased from about 13 to about 14 Gm. % (Gm. per 100 ml. of blood) and there were essentially no differences between the sexes. The average value for both the boys and the girls was 13.5 Gm. %, with standard deviations of 1.00 and 0.96.

In girls between 14 and 20 years of age the haeoglobin values decreased slightly, reaching about 13 Gm. %. In boys of corresponding ages there was an increase to about 15 Gm. %. In both sexes these values were attained at about 20 years of age, and remained characteristic of the third decade of life. They were essentially the lowest and the highest shown respectively by the female and the male subjects of any age group.

Haemoglobin values in men between 20 and 60 years of age were typically 14.5 to 15.0 Gm. %, the higher values tending to occur among the younger men. After the fifth decade there were progressive and marked decreases to an average of 12.4 Gm. % in men between 80 and 90 years of age.

In women from 20 years of age onward the average haemoglobin values remained near 13 Gm. %.

Analysis of the figures obtained for the various age groups of both sexes showed standard deviations ranging from 0.69 to 1.73, with usual values of about 1.

THE EFFECTS OF VISIBLE RADIATION ON THE OVOTESTIS OF THE SLUG, *Deroceras Reticulatum* (MULLER). D. PELLUET AND N. E. HENDERSON. (Read February 8, 1954.) A brief summary is given of spermatogenesis in the hermaphroditic slug, *Deroceras reticulatum.*

The abnormal types of male germ cells which normally occur in this species are described. Light, up to an intensity of 1,500 mc., induced a rapid maturation of male germ cells (which resulted in a loss of organization within the follicles) following which senescent changes occurred within the gonad. Animals kept in total darkness indicated a premature senescence, so that some light is required in the normal environment of these nocturnal animals. Intensities of light beyond 1,500 mc. inhibited both nuclear and cytoplasmic division in spermatocyte cells, but not their differentiation. Thus, both primary and secondary spermatocytes matured directly, having omitted both meiotic divisions. The inhibition of cytoplasmic divisions was also manifested in the increase of binucleate spermatocytes and the large proportion of multinucleate spermatids. Temperature increases of only a few degrees above normal room temperature were also effective in producing similar responses, but these were overshadowed by changes comparable to those occurring in heat-sterility in vertebrates. The mechanism by which light and heat may act to produce these changes is discussed.

DIFFRACTION OF AN ACOUSTIC WAVE OBLIQUELY INCIDENT UPON A PLANE OBSTACLE. H. S. HEAPS. (Read February 8, 1954.) Some calculations have been undertaken to determine the variation of sound pressure in the region behind a rigid plane disc irradiated by a plane wave of sound. The dimensions of the disc are assumed to be comparable to the wavelength of the incident sound. Comparison is made with the case in which the plane of the disc is at right angles to the direction of the wave.

THE EXPANSION OF MONOMOLECULAR FILMS OF PROTEIN. J. GORDIN KAPLAN and M. J. FRASER. (Read February 8, 1954.) It has been known for some time that a monolayer of protein maintained at constant surface pressure at the air /water interface will tend to expand with time. An alternative of hypotheses is available to explain this phenomenon: 1. There is a progressively more complete unfolding of the protein molecules themselves as a result of the asymmetric field of force at the interface; 2. There is a progressive, irreversible adsorption at the interface of molecules which had escaped to the bulk phase at the time of spreading. Hypothesis 1 seems to be accepted at the present time, although Irving Langmuir suggested in 1938 that progressive migration to the surface of originally dissolved molecules might account for changes in area of protein films with pH. We have devised a very simple two-trough experiment to decide in favour of one or the other of these hypotheses. Our results with ovalbumin show that intrinsic molecular re-arrangement at this interface occurs only during the first five minutes, and that the progressive increase in film area thereafter is due to migration to, and adsorption at, the interface of protein which had escaped into the bulk phase. Some of the interesting biological consequences of this finding are discussed.

FUNDAMENTAL PARTICLES IN THE COSMIC RADIATION. J. G. RETALLACK. (Read March 8, 1954). Data from cosmic ray and big machine research of the last five years suggests that there are twenty-one fundamental particles with rest masses ranging from zero to greater than the mass of the proton. These particles are produced in very high energy nuclear collisions. It is suggested that these particles are not all fundamental, but that some are combinations of others. The current evidence will be presented and discussed.

Slide Culture of Tubercle Bacilli. I. Media and Methods. R. W. Reed. (Read April 12, 1954). A modified slide culture technique is described for the cultivation of tubercle bacilli from untreated sputum specimens. Cultures are examined for growth under the low power after six and fourteen days incubation. Nearly two hundred cultures of sputum from sanatorium patients were positive either on slide culture or on Herrold's egg-yolk agar. Sixty-seven per cent were positive by both methods. However, 87% were positive by slide culture while only 80% were positive on Herrold's. The greater sensitivity of the slide method was confirmed by quantitative studies. Slide cultures were positive in an average of ten days, Herrold's agar cultures in thirty-one days. It is suggested that because of its technical simplicity and the rapid development of positive cultures, the slide culture method warrants further trial as a diagnostic procedure.

Organo-Analytical Reagents-Aromatic Hydroxylamines. G. D. Lutwick and D. E. Ryan. (Read April 12, 1954). Aromatic hydroxylamines containing a carbonyl grouping d—to the oxime react much the same as cupferron but are stable to heat, light and air. These compounds are more sensitive to acids than cupferron; only titanium, zirconium, tin and vanadium are completely precipitated from five per cent acid solutions. Reaction involves inner complex formation except for tin; reduction of tin (IV) to tin (II) by the reagent seems a necessary prerequisite to precipitation.

The Gel Strength and Optical Acitivity of Carrageenin. D. A. I. Goring. (Read April 12, 1954). *Chondrus crispus* was extracted with 0.02 M aqueous sodium acetate at 100° C and the extract was separated into gel and sol fractions by addition of potassium chloride using Smith and Cook's method. Sub-fractionation of the gel fraction was then made in the same way. All fractions were converted to the sodium salt by dialysis. The sol fractions exhibited a marked decrease in both gel strength and specific rotation. The gel fractions showed a corresponding increase.

The whole plant was extracted with 0.02 M aqueous sodium acetate at 60° C, 100° C and 120° C successively and the gel strength and optical activity of the extracts were measured. The portions extractable at higher temperatures possessed lower gel strength and specific rotation. A control, obtained at 60° C, was also subjected to the higher temperatures used; this showed a relatively small change in specific rotation and gel strength.

It was concluded that at least two structurally different polysaccharides exist in *Chondrus crispus*, separable by means of potassium chloride and designated gel and sol components. Extracts made at 60° C were rich in the gel component. The sol component was concentrated in extracts made at higher temperatures.

A Kinetic and Thermodynamic Study of Intracellular Yeast Catalase. M. J. Fraser. (Read May 3, 1954). In a previous paper from this laboratory presented before this Institute, it was shown that the great increase in activity (and changes in various other properties) of intracellular yeast catalase that is brought about when yeast cells are treated with various physical and chemical agents such as ultraviolet light, chloroform and propanol, is due to an "enzyme alteration". Enzyme alteration was defined as "a change in the properties of the enzyme itself resulting from the direct or indirect effect of the agents used, on the structure of the enzyme". In the present study the thermodynamic constants of the activation process, the experimental energy of activation (u), the heat of activation ($\triangle H^*$), the entropy of activation ($\triangle S^*$), the free-energy of activation ($\triangle F^*$), for the catalase-H_2O_2 reaction and for the heat inactivation, for both unaltered and altered intracellular catalase, have been determined from kinetic data on the rates of these reactions measured at various temperatures. The $\triangle H^*$ and $\triangle S^*$ values for the unaltered catalase-H_2O_2 reaction are respectively 4,500 cal/mole and 11 cal/mole deg. Abs. *higher* than those for the altered catalse-H_2O_2 reaction, while the $\triangle F^*$ value is 1.7 Kcal/mole higher for the unaltered catalase-H_2O_2 reaction. The $\triangle H^*$ and $\triangle S^*$ values for the heat inactivation of the unaltered yeast catalase are respectively 20,600 cal/mole and 70 cal/mole deg. Abs. *lower* than those for the heat inactivation of the altered enzyme, while the $\triangle F^*$ is 23.0 Kcal/mole for both states of the catalase. These differences in the thermodynamic constants for the two states of intracellular yeast catalase show that the unaltered enzyme is structurally less specific, and such results are consistent with the hypothesis that catalase of the living yeast cell exists in a partially unfolded condition at some intracellular interface.

POSITRON ANNIHILATION IN METALS. R. E. GREEN and A. T. STEWART. (Read May 3, 1954). Positrons and electrons annihilate one another converting their total mass into energy. The energy usually appears in the form of two gamma rays which, if the pair is at rest, are emitted at 180°. If either of them is moving before annihilation, the angle observed between the gamma rays departs from 180° by an amount which depends upon the velocity of the moving particle. In a metal there are many freely moving electrons. When a positron enters such a substance, it rapidly loses nearly all of its kinetic energy by collisions, after which it annihilates with one of the electrons. From a measurement of the angular distribution of the emitted gamma rays, information about the average velocity of the annihilating electrons is obtained.

Apparatus to measure the angular distribution of gamma rays from positron annihilation has been set up and measurements have been made on a series of metals. Results of this experiment are compared with other experimental and theoretical methods of obtaining the velocities of free electrons in metals.

AGE DETERMINATION OF A SUBMERGED TREE STUMP. BY CARBON 14 ANALYSIS. A. L. CARTER. (Read May 8, 1954). Carbon in living matter is radioactive with a specific activity of about fifteen counts per min. per gram. This activity arises from the isotope carbon 14 which has a half-life of 5570 years. Thus the amount of carbon 14 diminishes with time after metabolism ceases.

An apparatus has been constructed to extract carbon from organic matter pure enough to measure this extremely small carbon 14 concentration. These measurements are taken with the carbon pasted on the cathode of a Libby screen-wall G.M. counter which is shielded with one inch of mercury, a ring of anticoincidence counters and eight inches of iron. The age of a tree stump situated twenty feet below the high tide level near Avonport, N. S. has been determined by comparing its carbon 14 concentration to that of modern wood.

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